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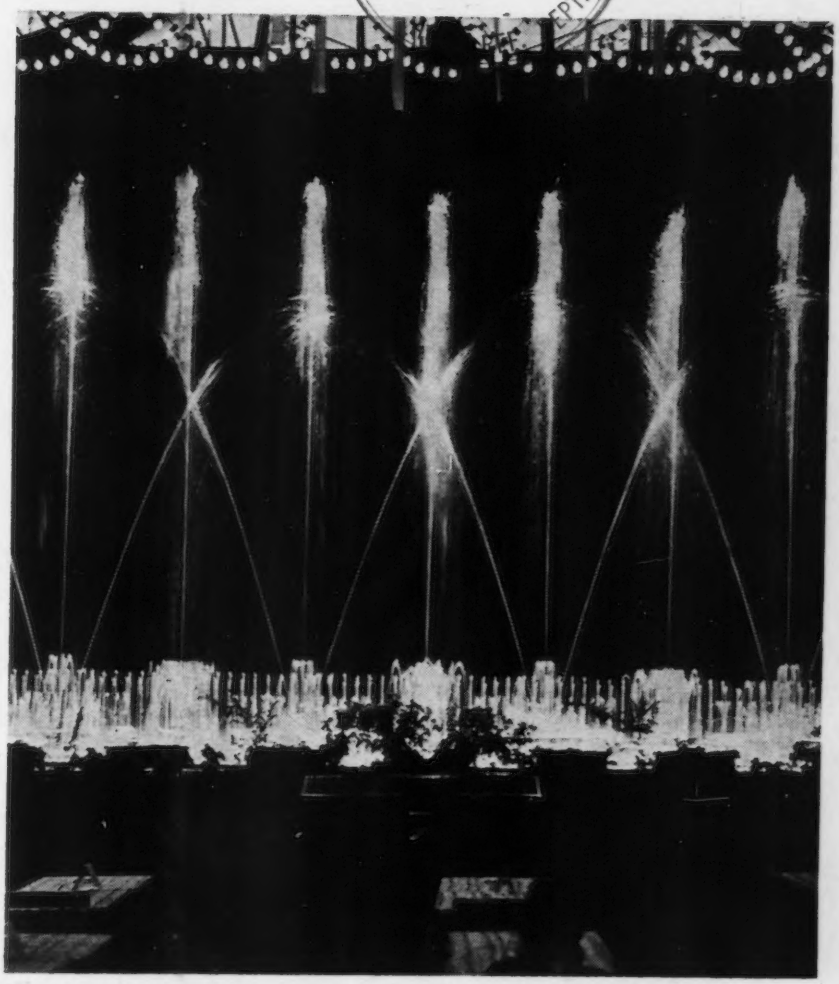

A partial scene of "Dancing Waters" which will be a featured spectacle each night at the Florida Citrus Exposition in Winter Haven Feb. 15-22. This show was first presented at Radio City Music Hall in this country and will be a permanent feature in Las Vegas after being shown at the Exposition.

VOL. 39 — NO. 2 FEBRUARY. 1958 BARTOW, FLORIDA

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# NEW! OLIVER Diesel Spra-Blast steps up air volume and fuel economy

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R. M. Pratt

# Citrus Insect Control

R. B. Johnson

## For February 1958

W. L. THOMPSON
R. M. PRATT
R. B. JOHNSON*
Florida Citrus Experiment Station, Lake Alfred

W. L. Thompson

Insect and mite populations in December and January were low with the exception of rust mite. This was in part due to the effect on population cycles of weather conditions occurring some weeks or months before, and in part, to the generally cold weather in the period that tends to reduce insect activity and reproduction. Preliminary observations following the freezing temperatures in December and January support observations made after other freezes that indicate there is little reduction in insect and mite populations as a direct result of freezing temperatures. This does not apply of course, to those removed from the trees by defoliation.

Purple scale infestations will increase in February, but there will be little change in the red scale population in that period.

The purple mite situation in February will be determined by the amount of rainy weather, because although the cold weather in December and January will tend to induce high purple mite populations this effect may be counteracted by above-average rainfall.

Six-spotted mites, on the other hand, can be expected to be numerous, even if the weather is wetter than normal. The number of infestations increased in January, and will increase sharply in February. Severe defoliation will follow in some groves, especially grapefruit, where these mites are not controlled.

Texas citrus mites will not be particularly abundant in Febraury.

Rust mite infestations were unusually heavy in December and January, and although there will be a declining trend in February, the level will remain rather high.

### SPRAY PROGRAM

As a result of the freezing weather in December and January and the subsequent defoliation or partial defoliation of many groves, the spray program for February will have to be adjusted for individual groves rather than an across the board program. During the average year, spray operations in February are not encouraged because the new foliage is very succulent and is easily injured by spray compounds and the force of the spray itself. On cold injured groves the immediate concern is to prevent the young leaves from being curled by aphids, injured by mites, melanose, and later in the year by scale insects.

Aphids are most likely to be a pest in groves where the new growth is retarded. Weekly inspections should be made for initial infestations and if the growth is still very succulent, treatments should be made before many leaves are curled.

All mite infestations should be controlled before the leaves become heavily infested. Close inspection should be made for six-spotted mites on the lower surfaces of the leaves. Inspect the leaves on lemon sprouts and mature leaves on the trees, especially those leaves infested with purple scale.

Purple scale has a history of increasing very rapidly following freezes that cause defoliation. Even though the scale infestations may not be of immediate concern, a close inspection for scale should be made on defoliated and partially defoliated trees so that plans can be made to apply a post-bloom scalicide where necessary.

APHID CONTROL: There are several aphicides that can be used but none of them has much residual effect, so several days to a week after the application an inspection should be made to determine whether another application is necessary. Continual inspections should be made until the growth has matured.

Nicotine sulfate (Black Leaf 40) at 1 pint per 100 gallons plus a spreader is one of the standard recommendations for aphid control. Two to three quarts of an oil emulsion per 100 gallons is a very good spreader and the oil will also control spider mites and check rust mite infestations. However, oil may be somewhat hazardous to use in early February because of the possibility of cold weather. Wettable sulfur at 5 pounds per 100 gallons can also be used as a spreader as well as other wetting agents.

TEPP, one of the phosphate compounds, is a good aphicide and should be used according to the manufacturer"s recommendations. Parathion (15 per cent) at 1 pound per 100 gallons can also be used.

Systox at 1 pint per 100 gallons is also an aphicide, and has more residual effect than the other materials.

(Continued on page 5)

SCALE AND MITE ACTIVITY BY DISTRICTS*

| District | Purple Scale | Red Scale | Purple Mite | Rust Mite on leaves | Rust Mite on fruit |
|---|---|---|---|---|---|
| West Coast | 2.73 | .23 | 1.08 | 2.24 | 1.75 |
| Indian River | 3.22 | 3.15 | 1.13 | 1.33 | 1.15 |
| Upper East Coast | 3.37 | -.25 | .37 | .25 | .50 |
| Gainesville | 2.00 | .50 | .34 | 1.20 | -.50 |
| Orlando | 1.88 | .84 | .22 | .21 | -.27 |
| Brooksville | 2.47 | .06 | .60 | 1.40 | 1.09 |
| Ridge | 3.61 | 2.20 | .74 | 2.45 | 1.90 |
| Bartow | 3.62 | 0 | .74 | 2.50 | 1.89 |
| State Average | 2.95 | 2.04 | .66 | 1.44 | 1.07 |
| Last Year | 3.10 | 3.04 | 1.25 | 1.73 | 1.48 |

* Second week in January. Activity is computed from populations, amount of hatching of scales, and number of groves with increasing or decreasing infestations. Activity is considered high if above 4.0 for purple scale, 3.0 for red scale, and 1.5 for mites.

Written January 24, 1958. Reports of surveys made by Harold Holtsberg, Fort Pierce; J. W. Davis, Tavares; K. G. Townsend, Tampa; T. B. Hallam, Avon Park: and L. M. Sutton, Lake Alfred.

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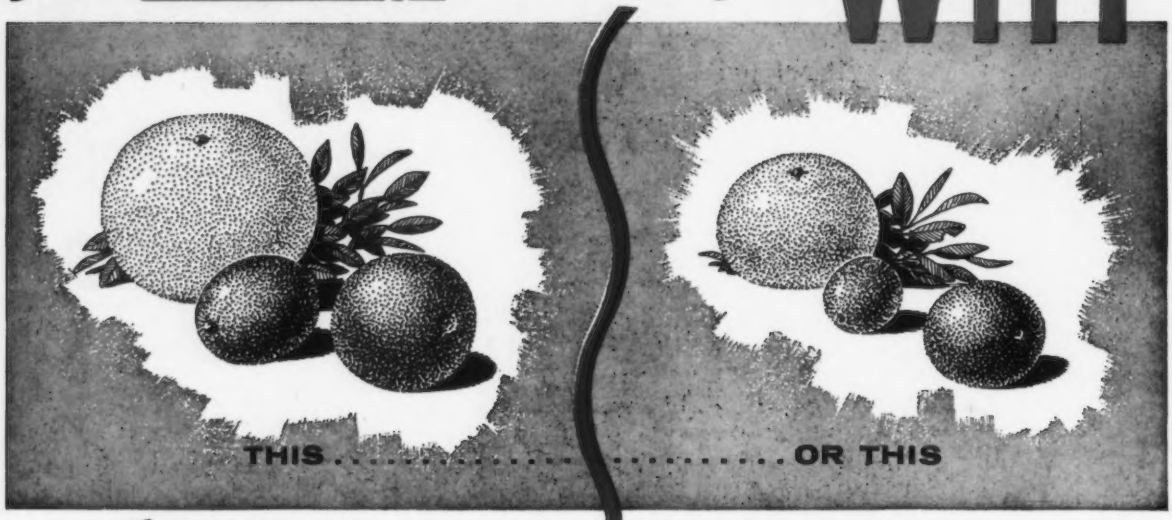


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## CITRUS INSECT CONTROL FOR FEBRUARY 1958

(Continued from page 3)

For satisfactory control with any aphicide, make the application during calm weather.

Scale control is only recommended where the infestation is too severe to wait until the post-bloom application because both oil and parathion may injure succulent foliage.

Rust mite control may be necessary in some groves before the post-bloom sprays. Either wettable sulfur at 10 pounds or ½ to 1 pound of zineb per 100 gallons is recommended. One gallon of lime-sulfur plus 5 pounds of wettable sulfur may be used, but the lime-sulfur may cause some leaf injury.

PURPLE MITE AND TEXAS CITRUS MITE CONTROL: These mites should be controlled before the new foliage becomes heavily infested. It is especially important to keep the new growth free of mite injury on trees that were defoliated. Aramite 45W at 2/3 pound, ovex at 1 pound, or Systox at 1 pint per 100 gallons are the recommended miticides. Ovex should not be used if it has been applied in the grove within the past year because mites become resistant to it.

There are three new materials that are very effective for the control of purple mite and Texas citrus mite. However, these materials should not be applied on trees with fruit on them because residue tolerances and waiting period between application and harvest have not been established.

Kelthane is recommended at 1 to 1.5 pints of the emulsion concentrate or 1 to 1.5 pounds of the wettable powder. It should not be used in alkaline solutions.

Tedion is recommended at ½ to 1 pound per 100 gallons. It is slow to kill, but it has controlled mites for longer periods than any of the miticides tested.

Trithion is recommended at ½ pint of the Flowable Trithion or 1 pound of the wettable powder per 100 gallons. This material has also been found to be about as effective for rust mite control as wettable sulfur but is not as effective as zineb. It is a reasonably safe material but it is an organic phosphate, and all precautions that appear on the manufacturers' label should be followed.

For more detailed information about the above miticides read the "Citrus Insect Control" article in the January issue of The Citrus Industry.

Six-spotted mites can be controlled with the same miticides used for purple mite control. Lime-sulfur at 2 gallons per 100 gallons is also fairly effective, but it should not be used on very succulent foliage. Because the six-spotted mites feed on under surfaces of the leaves, a thorough application is necessary with any miticide.

MELANOSE CONTROL: Trees that were not defoliated should be treated as usual; that is, delay the copper spray until the post-bloom application. On trees 8 years old or older, where melanose has become established, a copper spray before post-bloom will help protect the new foliage. Other fungicides, including zineb, have not given good melanose control. Trees that lost 15 to 50 per cent of their leaves can be sprayed at any time, especially where there is a large acreage to cover. Where more than 50 per cent of the leaves dropped it might be well to apply the copper spray when the young leaves are about half grown. Since young leaves are hard to wet, a wetting agent should be used. Wettable sulfur at 5 to 10 pounds can be used, especially if a zinc compound is also added. Where copper alone is used, 2 quarts of an oil emulsion per 100 gallons is a good spread and sticker. However, it is not known whether the small amount of oil will make the trees more susceptible to cold injury if a late February freeze should occur. A second application of copper will be necessary during the post-bloom period on trees with a crop of fruit.

Details of spray schedules and the various materials used will be found in the "Better Fruit Program" and this should be consulted to determine which materials may or may not be combined. For further information, consult the Citrus Experiment Station at Lake Alfred or Fort Pierce.

## NATIONAL BRAHMAN SHOW TO BE HELD IN BARTOW, MAR. 18-20

Plans for the Second Imperial National Brahman Show, scheduled for Bartow for March 18-20, are nearing completion, according to Eugene Griffin, chairman of the show committee.

The show, jointly sponsored by the Eastern Brahman Association and the American Brahman Breeders Association, will feature the International Breeders Sale with Brahman, Brangus, Charbray, and Santa Gertrudis cattle offered at auction.

THIS PICTURE TAKEN JANUARY 14, 1958

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The Citrus Industry
EXCLUSIVE SPECIALIZED CITRUS PUBLICATION
Issued Monthly
Representative of every interest
Representing no special interest

Publication office at Bartow, Florida. Entered as second class matter February 16, 1920, at the post office at Tampa, Florida, under act of March 3, 1879. Entered as second class matter June 19, 1933, at the post office at Bartow, Florida, under act of March 3, 1879.

# Florida Citrus Commission And Citrus Mutual Announce Plans For Quality Standards

A new and enlarged industry-wide research program on the characteristics and use of freeze-damaged oranges will be carefully considered by the Research Committee of the Florida Citrus Commission, General Manager Homer E. Hooks said recently.

"Although the freeze has been a serious blow to our industry, we hope to benefit from it by obtaining valuable information on what happens to an orange when it freezes and how we can best utilize it," Hooks said.

Hooks originally proposed more research on use of freeze-damaged oranges at a Commission meeting. At that time he said Tom B. Swann, of Winter Haven, chairman of the Commission's Research Committee, would call a meeting of his group soon to consider the scope of the new work.

"Immediate problems we are facing have to do with reprocessing concentrate packed in bulk since the freeze and in establishing suitable fruit quality tests for the coming Valencia orange crop, much of which is damaged," Hooks stated. "Then I think we should do some basic work on reviewing our grade standards to see if they accurately reflect the quality of our product."

He said there is some uncertainty about the relative "safe" period in which fruit can be shipped fresh or processed without restriction following a freeze. He said he hoped this could be further investigated.

"Our director of research, Dr. MacDowell, Dr. Fred W. Wenzel at the Citrus Experiment Station, Dr. George Westbrook of the State Inspection Division, have all done notable and important work which has guided the industry and the Commission through the current situation," Hooks added. "Now we want to enlarge the scope of their efforts, and to call upon individual plant laboratories to work with us in a coordinated inquiry that will give us information of great value in the unhappy event we should have another freeze."

---

Florida Citrus Mutual has announced that it will "vigorously oppose any relaxation" of quality standards, particularly on frozen concentrate.

"Mutual is committed to a program of quality improvement and maintenance of the highest possible quality standards," the announcement states.

"We shall not compromise on that program.

"Since the freeze of mid-December, some persons in the industry have pressed for relaxation of grade standards, especially for processed citrus products, in order to permit greater utilization of 'freeze-damaged fruit."

The big cooperative pointed out that many individuals had suffered heavy losses to their crops and "naturally wanted to 'salvage' whatever they could to recover as much money as possible from the current crop.

"But we must look not only at this season but, more important, at the years ahead.

"The good name of Florida citrus must be protected."

Mutual said the industry could be "justifiably proud of the fact it has self-imposed grade and quality standards which are the highest of any citrus producing area in the world.

"Mutual will vigorously oppose any relaxation of these standards.

"We have learned a lot since this freeze. It has been demonstrated, for illustration, that apparently a completely acceptable frozen orange concentrate can be produced by using certain percentages of fruit which show 'cold damage.'

"Technicians have done a superb job of making it possible to utilize all fruit that should be used, without lowering the standards for the end-product.

"Mutual must guard against any relaxation of standards which would affect the existing eager purchase of our citrus products by the industry's real boss—Mrs. Housewife."

# Storage Studies On Marsh Grapefruit--1955-56 Season

## I. Effect of Nitrogen and Potash Fertilization On Keeping Quality.
## II. Effect of Different Temperature Combinations On Keeping Quality.


### SUMMARY

Two series of storage tests with Marsh grapefruit grown on rough lemon rootstock were conducted at Orlando, Fla., during the 1955-56 season. One series consisted of three tests to determine the effect of fertilizing the soil with nitrogen and potash on keeping quality of grapefruit. The fruits tested were from plots given high, medium, and low levels of nitrogen and potash. The other series consisted of four tests to determine the effect of different temperature combinations on keeping quality of grapefruit obtained from commercial packinghouses.

Maturity of the fruit as well as conditions during storage and the subsequent holding period seemed to have more influence on the incidence of pitting and decay than nitrogen or potash fertilization of the trees. Very little pitting or decay was found in fruit stored 8 weeks at 50° F. Virtually all of the fruit stored 8 weeks at 40° was pitted and the remainder was decayed. Injured fruit soon developed decay during the holding period. Pitting increased rapidly during the 7-day holding period at 70° on fruit previously stored 8 weeks at 32°. Decay appeared between the third and seventh day at 70° and was much higher in the 8-week test than in the 6-week test. No pitting was found and decay developed very slowly in fruit stored 1 week at 50° and held 28 days at 70°. There was no consistent relation between levels of nitrogen and potash fertilization and pitting and decay.

Pitting in grapefruit obtained from commercial packinghouses did not become prevalent until the last 2 tests. These fruits were stored April 25 and May 8, 1956, respectively. Rind breakdown frequently was lower in fruit stored at 40° F., with or without previous storage at 50°, than in fruit stored at 32°. While it did not appear to affect the amount of pitting, storage of the fruit at 50° for 1 or 2 weeks before transferring it to 32° eliminated most of the surface browning so often found in fruit stored continuously at 32° and also prevented the appearance of the objectional deep yellow color found in fruit stored continuously at 50°.

In all 4 tests, decay in fruit stored continuously at 32°, 40°, and 50° F. (the so-called standard treatments) followed the same general pattern noted in previous years. Fruit stored at 50° nearly always developed considerable decay during storage. Those at 32° or 40° showed a more rapid appearance of decay during the holding period, especially between the third and seventh day. Less decay developed during the holding period when the fruit was stored 1 or 2 weeks at 50° before it was transferred to 32°. In most cases the shorter period at 50° gave better results. Some reduction in decay was also obtained when the lower temperature was 40°. Storage first at 32° and then at 50° was not successful as the amount of decay was higher than at continuous storage at 50°.



. . . By . . .

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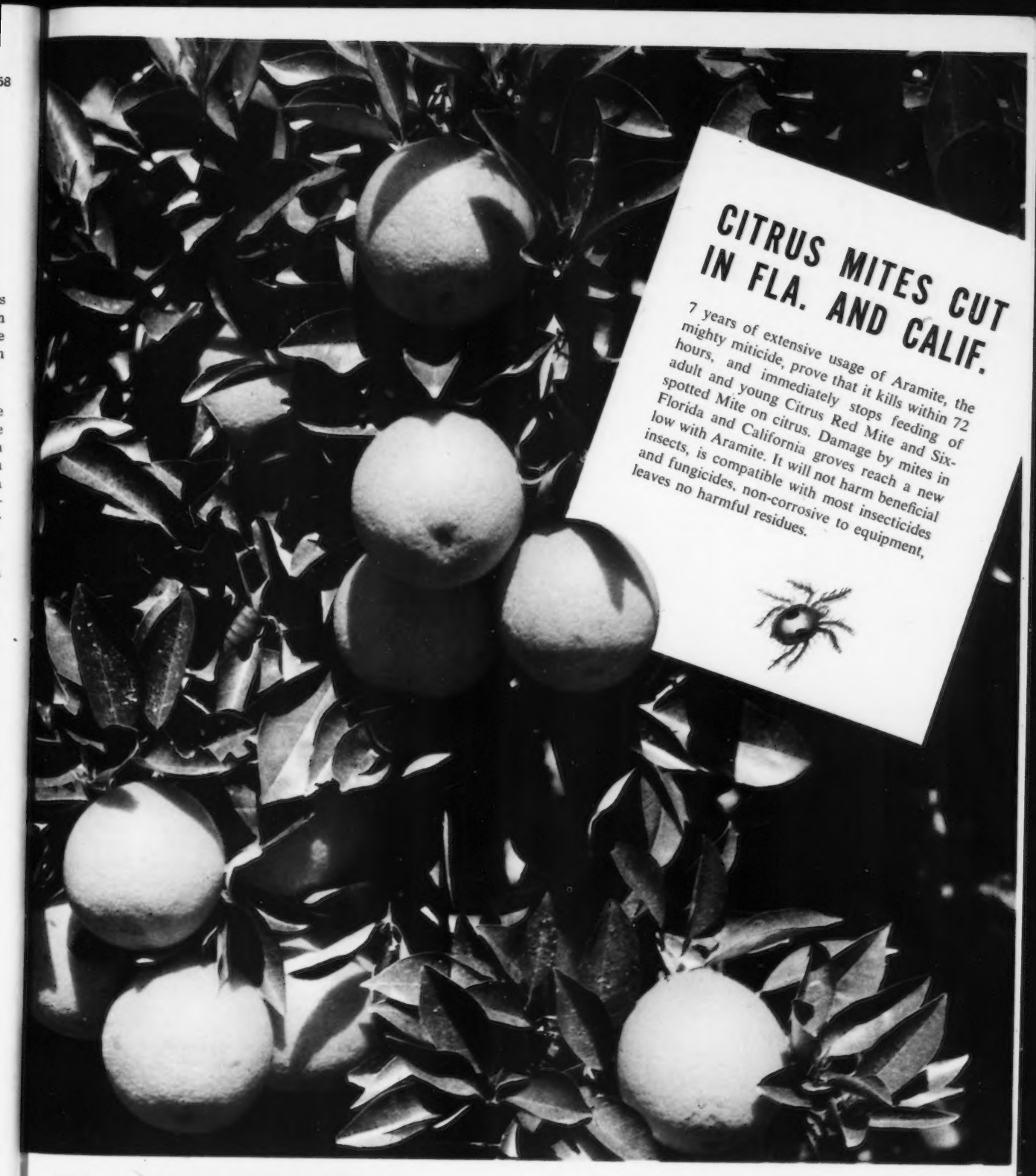
ORLANDO, FLA.


### REVIEW OF LITERATURE

In previous years considerable study has been made on the storage of grapefruit. The major effort in most instances has been focused on the determination of (a) optimum storage conditions and (b) packinghouse methods and treatments for the control of decay.

As far back as 1920 Hawkins and Magness (5) pointed out that an undesirable feature of cold storage was the breaking down or pitting of the peel at temperatures of 40° F. or lower. The authors described pitting and stated that this breaking down on the peel begins as a slightly sunken spot, which increases in size and becomes brown in color. The sunken portions are usually not more than one-half inch in diameter, but several may coalesce, making a large sunken area of dark-brown tissue. This does not extend into the pulp, and the flavor is apparently unaffected, but the fruit is rendered unsightly. Hawkins and Magness (5) stated that the best storage temperature seemed to be 32°, for at this temperature pitting was less marked. They pointed out that pitting of grapefruit does not apparently develop at high temperatures but occurs only on the cold-storage fruit.

In a rather comprehensive series of tests Brooks and McColloch (1) found that pitting was more prevalent in small lots of Florida grapefruit stored at 36° or 40° than 30°, 32°, 50°, or 60° F. Fruit stored at 30° or 32° for periods of 5 to 13 weeks had a form of mild pitting while that at 50° or 60° F. had little or no pitting. On removal to 70° F. fruit previously stored at 32° F. showed a greater increase in pitting than fruit from 36° F. They found a definite reduction in pitting when fruit was held for 4 to 10 days at 50° or 60° F. or for 8 to 24 hours at 100 to 110° F. before storage at 36°. The incidence of pitting was reduced when fruit was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removed from 32° or 36° F. to 70° F. (65° to 75° F.) or 60° F. for 1 day at the end of 1 week and again for 1 day at the end of 2 weeks. There was no reduction if the change was made after the fruit had been in storage at 32° or 36° F. for 3 weeks or more. Pitting was also partially inhibited when fruit was removed permanently from 32° or 36° to 50° F. at the end of 1, 2, or 3 weeks.

**Table 1.—Effect of nitrogen and potash fertilization on pitting and decay of Marsh grapefruit stored 8 weeks at 32°, 40° and 50° plus 3 and 7 days at 70° F.1**

| Fertilizer used on plot; level at which applied | Storage temperature | Number of fruits | Fruit pitted after 8 weeks' storage + indicated period at 70° F.2 | | | Fruit decayed after 8 weeks' storage + indicated period at 70° F.2 | | |
|---|---|---|---|---|---|---|---|---|
| | | | 0 day | 3 days | 7 days | 0 day | 3 days | 7 days |
| Nitrogen | F. | | Pct. | Pct. | Pct. | Pct. | Pct. | Pct. |
| High | 32° | 240 | 0 | 3 | 8 | 0 | 0 | 23 |
| Medium | | 240 | 0 | 5 | 4 9 | 0 | 0 | 18 |
| Low | | 240 | 0 | 5 | 17 | 0 | 0 | 28 |
| Potash | | | | | | | | |
| High | | 240 | 0 | 1 | 15 | 0 | 0 | 38 |
| Medium | | 240 | 0 | 5 | 5 | 0 | 0 | 40 |
| Low | | 240 | 1 | 3 | 19 | 0 | 0 | 32 |
| Nitrogen | | | | | | | | |
| High | 40° | 240 | 99 | 87 | 65 | 1 | 13 | 35 |
| Medium | | 240 | 95 | 83 | 52 | 5 | 17 | 48 |
| Low | | 240 | 97 | 80 | 33 | 3 | 20 | 67 |
| Potash | | | | | | | | |
| High | | 240 | 98 | 86 | 30 | 2 | 14 | 70 |
| Medium | | 240 | 98 | 82 | 43 | 2 | 18 | 57 |
| Low | | 240 | 98 | 90 | 64 | 2 | 10 | 36 |
| Nitrogen | | | | | | | | |
| High | 50° | 240 | 0 | 0 | 0 | 0 | 0 | 0 |
| Medium | | 240 | 0 | 1 | 1 | 1 | 1 | 2 |
| Low | | 240 | 1 | 1 | 2 | 0 | 0 | 1 |
| Potash | | | | | | | | |
| High | | 240 | 0 | 0 | 0 | 0 | 1 | 2 |
| Medium | | 240 | 1 | 1 | 4 | 1 | 3 | 3 |
| Low | | 240 | 1 | 1 | 2 | 1 | 1 | 3 |

1 Stored November 22, 1956.
2 Data not cumulative; includes moderate and severe pitting and severe aging.
3 Data cumulative; includes stem-end rot, Penicillium rot and miscellaneous decay.
4 Includes 1 percent severe aging.

Attempts to isolate possible causal organisms of pitting were made. Chiefly bacteria were found, at least one culture of which induced pitting when a dilute suspension was injected just under the rind of sound fruit. Brooks and McColloch also induced pitting by subjecting fruit to vapors of various chemicals. Extracts of peel oil from lemons and grapefruit when placed on the rind induced pitting in some instances, but more often resulted in oleocellosis. Pre-storage treatments with air mixtures of 25 to 45 percent carbon dioxide were helpful towards reducing pitting in fruit stored at 36° or 40° F.

Friend and Bach (2) working with Texas fruit reported that a temperature of 45° F. was more satisfactory for the storage of grapefruit than the lower temperatures. In this connection they stated that 31° to 32° retarded the development of decay in the stored fruit but increased the losses due to pitting and scald.

Stahl and Camp (8) stated that the best temperatures for the storage of Florida Silver Cluster and Marsh Seedless grapefruit were from 37.5° to 42° F., preferably 37.5°.

Ryall and Buford (7) reported that 46° to 50° F. was better than 32° to 34° or 38° to 40° for the storage of Texs grapefruit. Storage pitting was worse on grapefruit at 38° to 40°.

Johnson, Buford, and Ryall (6) reported successful storage of Marsh grapefruit for 8, 12, and 14 weeks in Texas. Their best results were obtained from storage at 52° F. in that pitting and surface browning were of minor importance and less Penicillium decay developed during the post-storage holding period.

Wiant, et al. (9) conducted storage investigations in 1951 on Florida Marsh and Duncan grapefruit at Orlando, Fla., and at New York, N. Y. They reported that storage for 8 weeks was completely unsuccessful because of the serious amount of pitting at 32° and 38° F. and the prevalence of decay at all temperatures (32°, 38°, 45° 50° and 55°). The results showed that decay developed rapidly during the holding period at 70° following storage. Also, they reported that where pitting occurred it was worse at 38° than at lower or higher temperatures.

Harding et al. (3, 4) reported storage studies on Florida grapefruit. Decay was not significantly reduced as a result of "curing" (60 hours at 84° F.) or packaging with phenodor-treated box liners. It was concluded that grapefruit can be successfully held at 32° for about 4 weeks. Some control of decay resulted from pre-storage treatments with Dowicide A (sodium orthophenylphenate) - hexamine (hexamethylene-tetramine) and 2-aminopyridine-pyrrolidine, but control was not sufficient to permit storage much longer than 4 weeks. The borax treatment (immersing the fruit for 10 seconds in a 5-percent solution of borax) weakened the fruit and made it susceptible to pitting and decay.

Harding et al. (4) determined the keeping quality of Florida grapefruit stored at 32° F. in polyethylene bags

**Table 2.—Changes in percentage of juice and chemical constituents in Marsh grapefruit picked from fertilizer test plots and stored 8 weeks at 32°, 40°, and 50° plus 7-day holding period at 70° F.1**

| Fertilizer used on plot; level at which applied | Storage temperature | Weight of fruit that was juice | Total soluble solids | Total acid | Solids-to-acid ratio | Acidity | Ascorbic acid per ml. |
|---|---|---|---|---|---|---|---|
| | | Before storage | | | | | |
| Nitrogen | F. | Pct. | Pct. | Pct. | | pH | Mg. |
| High | (Before storage) | 49 | 9.2 | 0.94 | 10:1 | 3.3 | 0.39 |
| Medium | | 49 | 9.2 | 0.90 | 10:1 | 3.3 | 0.42 |
| Low | | 49 | 9.2 | 0.85 | 11:1 | 3.4 | 0.45 |
| Potash | | | | | | | |
| High | | 49 | 9.9 | 1.00 | 10:1 | 3.3 | 0.42 |
| Medium | | 50 | 9.4 | 0.95 | 10:1 | 3.3 | 0.41 |
| Low | | 53 | 9.1 | 0.89 | 10:1 | 3.3 | 0.37 |
| | After 8 weeks storage and 7-day holding period | | | | | | |
| Nitrogen | | | | | | | |
| High | 32° | 49 | 8.5 | 0.89 | 10:1 | 3.4 | 0.36 |
| Medium | | 51 | 8.0 | 0.80 | 10:1 | 3.5 | 0.39 |
| Low | | 50 | 8.6 | 0.79 | 11:1 | 3.5 | 0.43 |
| Potash | | | | | | | |
| High | | 51 | 8.8 | 0.92 | 10:1 | 3.4 | 0.39 |
| Medium | | 50 | 8.4 | 0.87 | 10:1 | 3.3 | 0.40 |
| Low | | 51 | 8.7 | 0.78 | 11:1 | 3.4 | 0.34 |
| Nitrogen | | | | | | | |
| High | 40° | 52 | 8.6 | 0.94 | 9:1 | 3.4 | 0.38 |
| Medium | | 52 | 8.6 | 0.90 | 10:1 | 3.4 | 0.40 |
| Low | | 52 | 8.6 | 0.85 | 10:1 | 3.4 | 0.44 |
| Potash | | | | | | | |
| High | | 52 | 9.0 | 1.00 | 9:1 | 3.4 | 0.42 |
| Medium | | 54 | 8.4 | 0.90 | 9:1 | 3.3 | 0.39 |
| Low | | 53 | 8.9 | 0.83 | 11:1 | 3.3 | 0.36 |
| Nitrogen | | | | | | | |
| High | 50° | 51 | 8.6 | 0.90 | 10:1 | 3.4 | 0.38 |
| Medium | | 53 | 8.6 | 0.87 | 11:1 | 3.4 | 0.41 |
| Low | | 51 | 8.6 | 0.82 | 10:1 | 3.5 | 0.44 |
| Potash | | | | | | | |
| High | | 52 | 8.8 | 0.95 | 9:1 | 3.4 | 0.40 |
| Medium | | 51 | 8.4 | 0.88 | 10:1 | 3.4 | 0.39 |
| Low | | 54 | 8.7 | 0.79 | 11:1 | 3.4 | 0.35 |

1 Analyses made on composite samples of 25 fruit per treatment.

and lined boxes. They reported that carbon dioxide and oxygen atmospheres within the bags were partly controlled by breaking the seals on the bags at definite times. Some treatments showed promise for short storage periods, but 9 weeks at 32° proved too long, because high percentages of decay developed after removal from cold storage. Fruit stored in polyethylene bags was usually soft. If the seals were not broken on the polyethylene bags off-flavors developed in the fruit.

## MATERIALS AND METHODS

Storage studies on Marsh grapefruit were conducted during the 1955-56 season at Orlando, Fla. Fruit from trees on rough lemon rootstock in groves located in Lake and Pinellas Counties were used. Two series of tests were conducted one with grapefruit from soil fertilization plots[2] to determine the effect of nitrogen and potash fertilization on keeping quality, and the other with grapefruit from commercial packinghouses to determine the effect of different temperatures on pitting, decay, and storage quality.

The fertilization plots, which were in a grove near Groveland in Lake County, included replicated treatments of high, medium, and low levels of nitrogen and of potash.

**Test 1.** Fruit was picked from several trees in each of the plots having fertilization treatment on November 21, 1955. It was packed in Bruce boxes as size 80 (70-96) without washing or other treatment, and stored on November 22. Each subsample consisted of 3 boxes. The fruit was stored at 32°, 40°, and 50° F. for 8 weeks. Market life of the fruit after storage was determined by a holding period of 7 days at 70°.

Inspection of fruit was similar to that in former storage studies (3, 4, 9). Inspections were made at the time the boxes were removed from storage and after 3 and 7 days at 70° F. The fruit was scored for slight and severe aging, slight, moderate, and severe pitting, stem-end rot, Penicillium rot, and miscellaneous decay. Data for severe aging and moderate and severe pitting, the rind breakdown considered of commercial importance, are combined into a single group, pitting,

(Continued on page 12)

**Table 3.—Effect of nitrogen and potash fertilization on pitting and decay of Marsh grapefruit stored 6 weeks at 32° plus 3 and 7 days at 70° F.[1]**

| Fertilizer used on plot; level at which applied | Number of fruits | Fruit pitted after 6 weeks' storage + indicated period at 70° F.[2] | | | Fruit decayed after 6 weeks' storage + indicated period at 70° F.[3] | | |
|---|---|---|---|---|---|---|---|
| | | 0 day | 3 days | 7 days | 0 day | 3 days | 7 days |
| Nitrogen | | Pct. | Pct. | Pct. | Pct. | Pct. | Pct. |
| High | 384 | 0 | 1 | 2 | 0 | 0 | 8 |
| Medium | 384 | 0 | 1 | 1 | 0 | 0 | 7 |
| Low | 383 | 0 | 1 | 1 | 0 | 0 | 7 |
| Potash | | | | | | | |
| High | 384 | 0 | 3 | 3 | 0 | 0 | 14 |
| Medium | 382 | 0 | 1 | [4] 2 | 0 | 0 | 6 |
| Low | 400 | 0 | 2 | [4] 3 | 0 | 0 | 11 |

[1] Stored February 15, 1956.
[2] Data not cumulative; includes moderate and severe pitting and severe aging.
[3] Data cumulative; includes stem-end rot, Penicillium rot and miscellaneous decay.
[4] Includes 1 percent aging.

**Table 4.—Total soluble solids, total acid, solids-to-acid ratio, and flavor rating of Marsh grapefruit from fertilizer plots and stored 6 weeks at 32° plus 7-day holding period at 70° F.[1]**

| Fertilizer used on plot; level at which applied | Total soluble solids | Total acid | Solids-to-acid ratio | Flavor rating[2] |
|---|---|---|---|---|
| Nitrogen | Pct. | Pct. | | |
| High | 8.1 | 0.86 | 9:1 | 80 |
| Medium | 8.1 | 0.85 | 9:1 | 82 |
| Low | 7.4 | 0.76 | 10:1 | 79 |
| Potash | | | | |
| High | 7.7 | 0.87 | 9:1 | 79 |
| Medium | 7.8 | 0.79 | 10:1 | 80 |
| Low | 8.7 | 0.77 | 11:1 | 81 |

[1] Analyses made on composite samples of 25 fruit per treatment.
[2] 70-79 - pleasantly tart; 80-89 - pleasantly tart to sweet.

**Table 5.—Effect of nitrogen and potash fertilization on pitting and decay of Marsh grapefruit stored 1 week at 50° plus 3, 7, 14, 21, and 28 days at 70° F.[1]**

| Fertilizer used on plot; level at which applied | Number of fruits | Fruit pitted after 1 week's storage + indicated period at 70° F.[2] | | | | | | Fruit decayed after 1 week's storage + indicated period at 70° F.[3] | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0 day | 3 days | 7 days | 14 days | 21 days | 28 days | 0 day | 3 days | 7 days | 14 days | 21 days | 28 days |
| Nitrogen | | Pct. | Pct. | Pct. | Pct. | Pct. | Pct. | Pct. | Pct. | Pct. | Pct. | Pct. | Pct. |
| High | 384 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 6 | 11 |
| Medium | 384 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 4 | 7 |
| Low | 384 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 5 | 8 |
| Potash | | | | | | | | | | | | | |
| High | 381 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 5 |
| Medium | 318 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 3 |
| Low | 399 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 5 | 7 |

[1] Stored February 15, 1956.
[2] Data not cumulative; includes moderate and severe pitting and severe aging.
[3] Data cumulative; includes stem-end rot, Penicillium rot and miscellaneous decay.

**Table 6.—Effect of time and temperature on pitting and decay of Marsh grapefruit stored 8 weeks at specified temperatures plus 3 and 7 days at 70° F.[1]**

| Storage treatment | No. of fruits | Fruit pitted after 8 weeks' storage + indicated period at 70° F.[2] | | | Fruit decayed after 8 weeks' storage + indicated period at 70° F.[3] | | |
|---|---|---|---|---|---|---|---|
| | | 0 day | 3 days | 7 days | 0 day | 3 days | 7 days |
| 32° F. for — | | | | | | | |
| 8 weeks | 358 | 0 | 0 | 0 | 0 | 0 | 32 |
| 1 week, then 50° for 7 weeks | 356 | 0 | 0 | 0 | 15 | 18 | 24 |
| 2 weeks, then 50° for 6 weeks | 356 | 0 | 0 | 0 | 15 | 18 | 26 |
| 3 weeks, then 50° for 5 weeks | 360 | 0 | 0 | 0 | 12 | 17 | 26 |
| 4 weeks, then 50° for 4 weeks | 352 | 0 | 0 | 0 | 10 | 15 | 23 |
| 50° F. for — | | | | | | | |
| 8 weeks | 360 | 0 | 0 | 0 | 14 | 16 | 21 |
| 1 week, then 40° for 7 weeks | 360 | 0 | 0 | 0 | 1 | 3 | 15 |
| 2 weeks, then 40° for 6 weeks | 360 | 0 | [4] 1 | [4] 1 | 3 | 4 | 11 |
| 3 weeks, then 40° for 5 weeks | 360 | 0 | 0 | 0 | 3 | 6 | 15 |
| 4 weeks, then 40° for 4 weeks | 360 | 0 | 0 | 1 | 11 | 12 | 18 |
| 50° F. for — | | | | | | | |
| 8 weeks | 360 | 0 | 0 | 1 | 15 | 18 | 24 |
| 1 week, then 32° for 7 weeks | 360 | 0 | 0 | 0 | 0 | 0 | 9 |
| 2 weeks, then 32° for 6 weeks | 356 | 0 | 0 | 0 | 2 | 2 | 11 |
| 3 weeks, then 32° for 5 weeks | 360 | 0 | 0 | 0 | 1 | 1 | 15 |
| 4 weeks, then 32° for 4 weeks | 360 | 0 | 0 | 0 | 7 | 8 | 21 |

[1] Stored February 8, 1956; 4/5-bushel plain telescoped cartons.
[2] Data not cumulative; includes moderate and severe pitting and severe aging.
[3] Data cumulative; includes stem-end rot, Penicillium rot and miscellaneous decay.
[4] Severe aging.

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## STORAGE STUDIES ON MARSH GRAPEFRUIT—55-56 SEASON

(Continued from page 10)

for purposes of this report. Records for pitting at the second and third inspections are based on counts made at the particular inspection and are not cumulative. Decayed grapefruit at the first and second inspections were discarded and the sound fruit repacked, hence the data for decay are cumulative.

A composite sample (25 fruit) from each fertilization treatment was analyzed before storage for weight of fruit that was juice, total soluble solids, total acid, solids-to acid ratio, and ascorbic acid (milligrams per milliliter). Similar analyses were made on the treatments from each of the storage temperatures at the end of the holding period. Flavor of fruit in the high, medium, and low levels of nitrogen and potash was rated by a taste panel.

**Test 2.** A second picking from the fertilization plots was made February 14, 1956. The fruit was packed in Bruce boxes as size 64 without washing or other treatment and stored February 15. The storage temperature was 32° F. and the storage period was 6 weeks. Each subsample consisted of 6 boxes. Inspections were made and data recorded as in the previous test. Rind color was observed at each inspection. Analyses were made for total soluble solids, total acid, and solids-to-acid ratio at the end of the holding period. Flavor of fruit was rated by a taste panel.

**Test 3.** Additional boxes of grapefruit from each fertilization treatment were picked on February 14. Unwashed fruit was packed in Bruce boxes as size 64 and stored February 15. The fruit was stored at 50° F. for 1 week. Market life of the fruit after storage, which simulated transit to a northern market, was determined by a holding period of 28 days at 70°. The fruit was inspected when the boxes were removed from 50° and after 3, 7, 14, 21, and 28 days' holding. Data were recorded as in the previous test except that no analyses or flavor ratings were made.

To determine the effect of time and temperature on keeping quality Marsh grapefruit used in tests was obtained from commercial packinghouses in Lake and Pinellas Counties. The commercial packinghouse treatments consisted of washing, waxing, polishing, grading, sizing, and packing. Fruit of size 72 and grade U. S. 1 was packed in 4/5-bushel plain telescope cartons in one test, and in 1-3/5-bushel Bruce boxes in the other three. Each subsample consisted of 10 cartons or 6 boxes. These tests were as follows:

**Test 4.** Eight weeks' storage test with Lake County fruit in cartons: Picked February 6, 1956, and packed and stored February 8. Fifteen treatments: 32° F. for 8 weeks; 32° for 1, 2, 3, and 4 weeks, then 50° for 7, 6, 5, and 4 weeks, respectively; 50° for 8 weeks; 50° for 1, 2, 3, and 4 weeks, then 40° for 7, 6. 5, and 4 weeks; 50° for 8 weeks; and 50° for 1, 2, 3, and 4 weeks, then 32° for 7, 6, 5, and 4 weeks.

**Test 5.** Six weeks' storage test with Lake County fruit: Picked April

**Table 7.—Total soluble solids, total acid, and solids-to-acid ratio of Marsh grapefruit stored 8 weeks at specified temperatures, plus 7 days at 70° F.1**

| Storage treatment (plus 7 days at 70° F.) | Total soluble solids | Total acid | Solids-to-acid ratio |
|---|---|---|---|
| | Pct. | Pct. | |
| 32° F. for — | | | |
| 8 weeks[2] | 10.8 | 1.27 | 8:1 |
| 1 week, then 50° for 7 weeks | 10.3 | 1.28 | 8:1 |
| 50° F. for — | | | |
| 8 weeks | 10.7 | 1.20 | 9:1 |
| 1 week, then 40° for 7 weeks | 10.7 | 1.30 | 8:1 |
| 1 week, then 32° for 7 weeks | 10.7 | 1.28 | 8:1 |

1 Analyses made on composite samples of 15 fruit per treatment.
2 Twelve fruit.

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**Table 8.—Effect of time and temperature on pitting and decay of Marsh grapefruit stored 6 weeks at specified temperatures plus 3 and 7 days at 70° F.**

| Date stored and storage treatment | Number of fruits | Fruit pitted after 6 weeks' storage + indicated period at 70° F.1 | | | Fruit decayed after 6 weeks' storage + indicated period at 70° F.2 | | |
|---|---|---|---|---|---|---|---|
| | | 0 day | 3 days | 7 days | 0 day | 3 days | 7 days |
| **April 12, 1956[3]** | | | | | | | |
| 50° F. for — | | Pct. | Pct. | Pct. | Pct. | Pct. | Pct. |
| 6 weeks | 428 | [4] 1 | [4] 1 | 0 | 22 | 28 | 44 |
| 1 week, then 32° for 5 weeks | 422 | 0 | [4] 1 | 0 | 2 | 4 | 46 |
| 2 weeks, then 32° for 4 weeks | 429 | 0 | [4] 2 | [4] 1 | 4 | 7 | 36 |
| 40° for 6 weeks | 432 | 0 | [5] 2 | [4] 2 | 3 | 11 | 31 |
| 50° for — | | | | | | | |
| 1 week, then 40° for 5 weeks | 432 | [4] 3 | [4] 4 | | | 12 | 46 |
| 2 weeks, then 40° for 4 weeks | 432 | [4] 2 | [4] 2 | [4] 3 | 5 | 12 | 46 |
| 32° for 6 weeks | 435 | 0 | 2 | [4] 1 | 7 | 16 | 48 |
| | | | | 2 | 0 | 3 | 77 |
| **April 25, 1956[6]** | | | | | | | |
| 50° F. for — | | | | | | | |
| 6 weeks | 429 | 0 | 0 | 0 | 8 | 16 | 27 |
| 1 week, then 32° for 5 weeks | 428 | 0 | 5 | 4 | 1 | 1 | 17 |
| 2 weeks, then 32° for 4 weeks | 427 | 0 | 0 | 0 | 1 | 1 | 12 |
| 40° for 6 weeks | 431 | 0 | 2 | 1 | 1 | 3 | 19 |
| 50° for — | | | | | | | |
| 1 week, then 40° for 5 weeks | 430 | 0 | 1 | 1 | 1 | 3 | 18 |
| 2 weeks, then 40° for 4 weeks | 427 | 0 | 1 | 1 | 1 | 3 | 17 |
| 32° for 6 weeks | 432 | 3 | 11 | 6 | 0 | 1 | 52 |

1 Data not cumulative; includes moderate and severe pitting and severe aging.
2 Data cumulative; includes stem-end rot, Penicillium rot and miscellaneous decay.
3 Packinghouse A, Lake County.
4 Severe aging.
5 Includes 1 percent severe aging.
6 Packinghouse B, Pinellas County.

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9, 1956, packed April 10, and stored April 12. Seven treatments: 32°, 40°, and 50° F. for 6 weeks; 50° for 1 and 2 weeks, then 32° for 5 and 4 weeks, respectively; and 50° for 1 and 2 weeks, then 40° for 5 and 4 weeks.

**Table 9.—Changes in percentage of juice and chemical constituents of Marsh grapefruit stored 6 weeks at specified temperatures plus 7-day holding period at 70° F.[1]**

| Date stored and storage treatment | Weight of fruit that was juice | Total soluble solids | Total acid | Solids-to-acid ratio | Acidity |
|---|---|---|---|---|---|
| Before storage | — | 10.1 | 1.10 | 9:1 | — |
| **April 12, 1956[2]** | Pct. | Pct. | Pct. | | pH |
| 50° F. for — | | | | | |
| 6 weeks | — | 10.4 | 1.07 | 10:1 | — |
| 1 week, then 32° for 5 weeks | — | 10.5 | 0.86 | 12:1 | — |
| 2 weeks, then 32° for 4 weeks | — | 10.5 | 0.93 | 11:1 | — |
| 40° for 6 weeks | — | 10.4 | 0.95 | 11:1 | — |
| 50° for — | | | | | |
| 1 week, then 40° for 5 weeks | — | 10.5 | 0.96 | 11:1 | — |
| 2 weeks, then 40° for 4 weeks | — | 10.5 | 0.91 | 12:1 | — |
| 32° for 6 weeks | — | 11.1 | 0.97 | 11:1 | — |
| **April 25, 1956[3]** | | | | | |
| Before storage | 46 | 10 0 | 1.13 | 9:1 | 3.4 |
| 50° F. for — | | | | | |
| 6 weeks | 50 | 10.3 | 0.96 | 11:- | 3.5 |
| 1 week, then 32° for 5 weeks | 46 | 10.2 | 0.87 | 12:1 | 3.6 |
| 2 weeks, then 32° for 4 weeks | 47 | 10.1 | 0.91 | 11:1 | 3.5 |
| 40° for 6 weeks | 47 | 10.3 | 0.97 | 11:1 | 3.5 |
| 50° for — | | | | | |
| 1 week, then 40° for 5 weeks | 48 | 10.0 | 0.96 | 10:1 | 3.5 |
| 2 weeks, then 40° for 4 weeks | 46 | 10.2 | 0.97 | 11:1 | 3.5 |
| 32° for 6 weeks | 48 | 10.2 | 0.95 | 11:1 | 3.5 |

1 Analyses made on composite samples of 25 fruit per treatment.
2 Packinghouse A, Lake County
3 Packinghouse B, Pinellas County.

**Test 6.** Six weeks' storage test with Pinellas County fruit: Picked April 24, 1956, packed and stored April 25. Seven treatments as in test 5.

**Test 7.** Four, 6, and 8 weeks' storage test with Lake County fruit: Picked May 8, 1956, packed May 9, and stored May 10. Fifteen treatments: 32°, 40°, 50° F. for 4, 6, and 8 weeks; 50° for 1 week, then 32° for 3, 5, and 7 weeks; and 50° for 1 week, then 40° for 3, 5, and 7 weeks.

Inspections were made at the time the cartons or boxes were removed from storage and after 3 and 7 days at 70° F. Data on pitting, decay, and rind color were recorded as in the previous tests. Total soluble solids, total acid, and solids-to-acid ratio were determined on composite samples (15 fruit) for 5 of the treatments in test 4 at the end of the holding period. These constituents, weight of fruit that was juice, and acidity (pH) were determined on composite samples (25 fruit) for all of the treatments in tests 5, 6, and 7 before storage and at the end of the holding period. Flavor of the fruit was judged by an informal taste panel.

## RESULTS AND DISCUSSION

### I Effect of Nitrogen and Potash Fertilization on Keeping Quality

**Test 1.** Marsh grapefruit picked from plots given high, medium, and low levels of nitrogen and potash fertilization showed very little pitting after 8 weeks' storage at 32° or 50° F. (table 1). Virtually all of the fruit stored at 40° was pitted upon removal. Pitting increased appreciably in the 32° lots and very little in the 50° lots during the holding period at 70°. Many of the injured fruit of the 40° lots quickly succumbed to decay so that the apparent amount of pitting decreased. These results were similar to those reported in previous storage tests (1, 3, 4, 7, 9). Trends among the different levels of nitrogen and potash were not consistent from one storage temperature to another. The amount of pitting decreased with increased level of nitrogen at 32° and 50° but showed an opposite trend at 40°. At 32° less pitting was found in medium potash fruit than the high or low levels and at 50°, the reverse was true.

No decay was found in lots stored 8 weeks at 32° F., and very little at 50° upon removal of the fruit from storage. Decay appeared in the 32° lots between the third and seventh day of the holding period and ranged from 18 to 40 percent at the end of the holding period. Only 0 to

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3 percent decay was found in the 50° lots at the final inspection. More decay was recorded in the 40° lots than the others at the time of removal from storage and it increased rapidly during the holding period. In general, fruit in the 3 nitrogen lots showed somewhat less decay than the potash.

Fruit from the low potash plots contained somewhat more juice and generally lower total soluble solids, total acid, and ascorbic acid than those from the other plots (table 2). Differences among the fruit and changes during storage and the holding period were small. All of the lots decreased somewhat in solids and usually in acid but increased in weight of fruit that was juice. Fruit of the high, medium, and low levels of nitrogen and potash were all pleasantly tart to sweet in flavor.

**Test 2.** No pitting or decay was found in grapefruit stored 6 weeks at 32° when the fruit was removed from storage (table 3). Contrary to the previous test, little pitting developed during the holding period. Decay appeared between the third and seventh day of holding at 70° but was much lower in all lots than in the 8 weeks' test. Fruit showing less pitting also had less decay. Except for the medium potash fruit the nitrogen lots had less decay than the potash.

Total soluble solids, total acid, and solids-to-acid ratio (table 4) tended to be lower than in the previous test. All of the fruit was pleasantly tart to sweet in flavor. Fruit in the potash lots were noticeably greener in rind color but all tended to develop yellow rind color during storage and the holding period.

**Test 3.** Grapefruit stored for 1 week at 50° and held for 28 days at 70° showed no sign of pitting (table 5). Decay developed very slowly during the holding period. Unlike the storage tests more decay appeared in the nitrogen lots than in the potash. After 28 days at 70° F. the medium level of potash showed the least decay, 3 percent, and the high level of nitrogen the most, 11 percent. The rind color of the potash fruit was somewhat greener than the nitrogen at the beginning of the storage period but this difference gradually disappeared during the holding period. All of the fruit was pleasantly tart to sweet in flavor. The lowest rating, 81, was given to the low potash fruit which were smaller than the general average, and the highest, 85, to fruit in each of the 3 levels of nitrogen.

The foregoing results indicate that fertilization with high, medium, and low levels of nitrogen or potash has less influence on the incidence of pitting and decay than maturity of the fruit and conditions during the storage and marketing periods.

**II Effect of Different Temperature Combinations on Keeping Quality**

(Continued on page 16)

**Table 10.—Effect of time and temperature on pitting and decay of Marsh grapefruit stored 4, 6, and 8 weeks at specified temperatures plus 3 and 7 days at 70° F.1**

| Storage treatment | Number of fruits | Fruit pitted after storage + indicated period at 70° F.2 | | | Fruit decayed after storage + indicated period at 70° F.2 | | |
|---|---|---|---|---|---|---|---|
| | | 0 day | 3 days | 7 days | 0 day | 3 days | 7 days |
| | | Pct. | Pct. | Pct. | Pct. | Pct. | Pct. |
| 50° F. for — | | | | | | | |
| 4 weeks | 429 | 4 2 | 1 | 1 | 17 | 23 | 37 |
| 1 week, then 32° for 3 weeks | 429 | 2 | 2 | 2 | 1 | 3 | 20 |
| 40° for 4 weeks | 429 | 0 | 1 | 1 | 2 | 7 | 26 |
| 50° for — | | | | | | | |
| 1 week, then 40° for 3 weeks | 431 | 0 | 1 | 1 | 2 | 7 | 26 |
| 32° for 4 weeks | 429 | 0 | 2 | 4 1 | 1 | 1 | 38 |
| 50° F. for — | | | | | | | |
| 6 weeks | 432 | 5 2 | 1 | 5 1 | 27 | 36 | 51 |
| 1 week, then 32° for 5 weeks | 432 | 1 | 6 | 4 5 | 1 | 2 | 25 |
| 40° for 6 weeks | 432 | 1 | 1 | 1 | 2 | 7 | 40 |
| 50° for 1 week, then | | | | | | | |
| 40° for 5 weeks | 431 | 5 1 | 4 2 | 4 3 | 3 | 8 | 30 |
| 32° for 6 weeks | 428 | 1 | 8 | 1 | 2 | 3 | 41 |
| 50° F. for — | | | | | | | |
| 8 weeks | 432 | 0 | 0 | 0 | 33 | 42 | 58 |
| 1 week, then 32° for 7 weeks | 432 | 2 | 4 9 | 4 3 | 2 | 2 | 48 |
| 40° for 8 weeks | 430 | 1 | 4 3 | 4 2 | 3 | 10 | 50 |
| 50° for 1 week, then | | | | | | | |
| 40° for 7 weeks | 430 | 6 4 | 4 2 | 1 | 6 | 16 | 48 |
| 32° for 8 weeks | 428 | 4 | 13 | 1 | 1 | 15 | 85 |

1 Stored May 10, 1956.
2 Data not cumulative; includes moderate and severe pitting and severe aging.
3 Data cumulative; includes stem-end rot, Penicillium rot, and miscellaneous decay.
4 Includes 1 percent severe aging.
5 Severe aging.
6 Includes 3 percent severe ging.

**Table 11. — Changes in percentage of juice and chemical constituents of Marsh grapefruit stored at 4, 6 and 8 weeks at specified temperature plus 7-day holding period at 70° F.1**

| Storage treatment | Weight of fruit that was juice | Total soluble solids | Total acid | Solids-to-acid ratio | Acidity |
|---|---|---|---|---|---|
| | Pct. | Pct. | Pct. | | pH |
| Before storage | 46 | 11.4 | 1.07 | 11:1 | 3.6 |
| 50° F. for — | | | | | |
| 4 weeks | 43 | 11.7 | 0.94 | 12:1 | 3.6 |
| 1 week, then 32° for 3 weeks | 43 | 11.6 | 0.81 | 14:1 | 3.7 |
| 40° for 4 weeks | 44 | 11.6 | 0.84 | 14:1 | 3.7 |
| 50° for 1 week, then | | | | | |
| 40° for 3 weeks | 43 | 11.9 | 0.86 | 14:1 | 3.7 |
| 32° for 4 weeks | 44 | 11.6 | 0.87 | 13:1 | 3.6 |
| 50° F. for — | | | | | |
| 6 weeks | 41 | 11.2 | 0.81 | 14:1 | 3.7 |
| 1 week, then 32° for 5 weeks | 42 | 11.2 | 0.75 | 15:1 | 3.7 |
| 40° for 6 weeks | 44 | 11.2 | 0.81 | 14:1 | 3.7 |
| 50° for 1 week, then | | | | | |
| 40° for 5 weeks | 44 | 11.2 | 0.81 | 14:1 | 3.7 |
| 32° for 6 weeks | 41 | 11.3 | 0.81 | 14:1 | 3.7 |
| 50° F. for — | | | | | |
| 8 weeks | 41 | 11.9 | 0.80 | 15:1 | 3.7 |
| 1 week, then 32° for 7 weeks | 43 | 11.5 | 0.78 | 15:1 | 3.8 |
| 40° for 8 weeks | 44 | 11.5 | 0.78 | 15:1 | 3.8 |
| 50° for 1 week, then | | | | | |
| 40° for 7 weeks | 42 | 11.5 | 0.82 | 14:1 | 3.8 |
| 32° for 8 weeks | 42 | 11.6 | 0.79 | 15:1 | 3.7 |

1 Analyses made on composite samples of 25 fruit per treatment.

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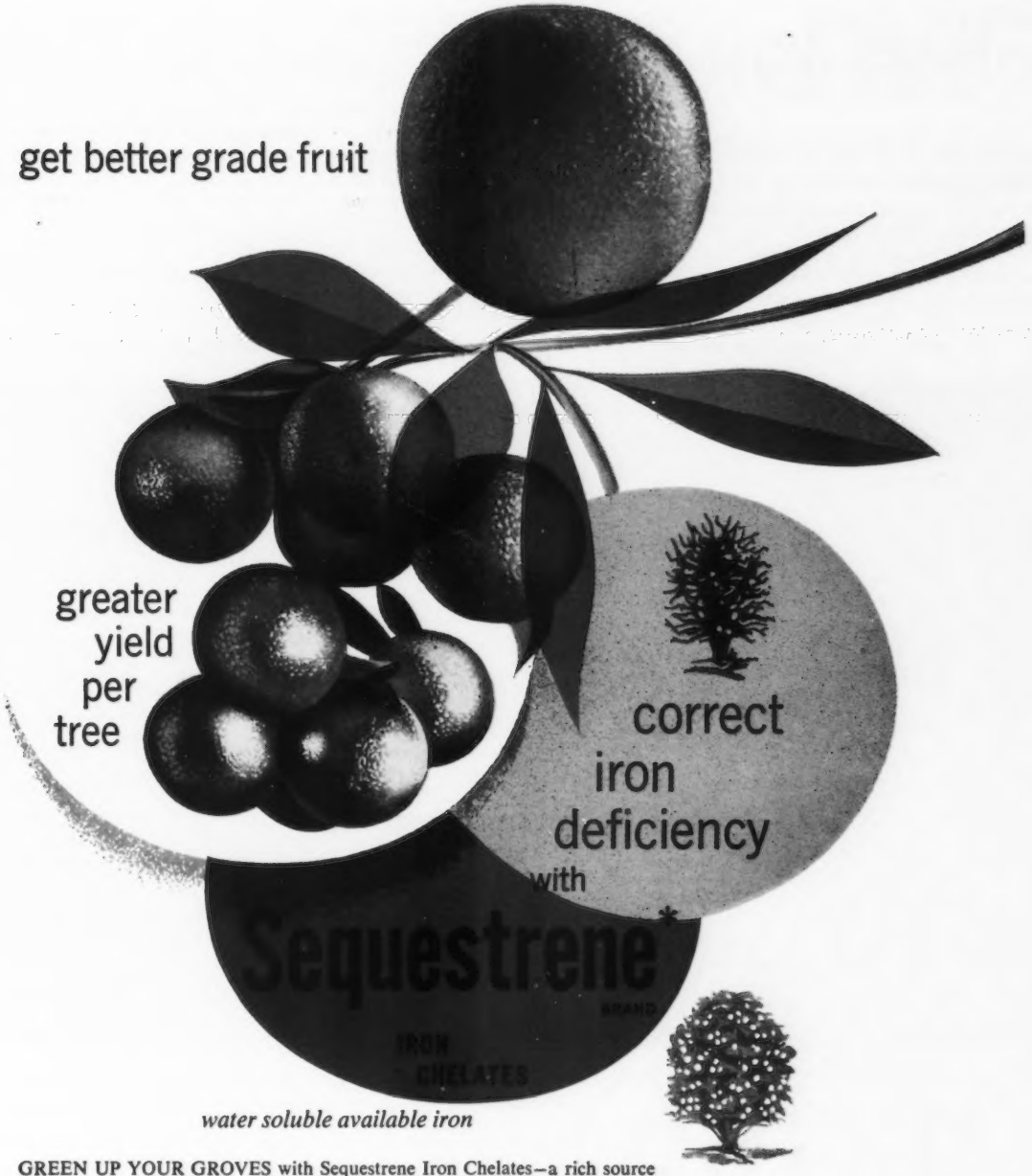


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## STORAGE STUDIES ON MARSH GRAPEFRUIT—55-56 SEASON

(Continued from page 14)

**Test 4.** Thirteen of the 15 treatments showed no pitting whatever after 8 weeks' storage and 7 days at 70° F. (table 6). A treatment with fruit stored 8 weeks at 40° was not included in the test but very little pitting (or severe aging) appeared in fruit stored 1 to 4 weeks at 50°, then 40° for 7 weeks. So little pitting was found that no conclusions could be drawn as to the influence of the different treatments upon rind breakdown.

As expected from results of previous storage tests (3, 4, 7, 9), the highest percentages of decay when the boxes were removed from storage were in treatments where the fruit was stored 4 to 8 weeks at 50° F. Storage for 1 to 4 weeks at 32° before transferring the fruit to 50° resulted in little or no decrease in decay. Storage for 1 to 3 weeks at 50°, however, reduced decay markedly and the effect was greater where the second temperature was 32° instead of 40°. Fruit stored 8 weeks at 32° had 32 percent decay at the end of the holding period while that stored 1 week at 50° then 32° for 7 weeks had only 9 percent. Storage for 2 or 3 weeks at 50° then 6 or 5 weeks at 32° or 1 to 3 weeks at 50° then 7 to 5 weeks at 40° gave somewhat more decay at the end of the holding period but the percentages were still lower than the 32° or 50° controls. Fruit stored 4 weeks at 50° then 4 weeks at either 40° or 32° had the same or somewhat less decay than the 50° control.

Total soluble solids, total acid, and solids-to-acid ratio were comparable in the 5 treatments which were analyzed (table 7). Changes in rind color were slight except in the case of fruit stored for the longer periods at 50°. The latter were deep yellow when they were removed from storage. Most of the other treatments had approximately the same light yellow or light greenish yellow color which they had when stored. All of the fruit deepened in yellow color during the holding period and this was most noticeable in fruit stored at 50° for 3 to 8 weeks. No storage or other "off taste" was detectable in the fruit when tasted at the conclusion of the test.

Numerous experiments with curing of fruit at high temperatures have been reported in the literature. Curing of oranges and grapefruit was often recommended as a commercial practice and short curing periods such as would be obtained in the degreening process are still considered beneficial towards suppression of certain types of decay, notably Penicllium rots. The results obtained in the present test corroborate those of Brooks and McColloch (1) with regard to the possible curing effect of a regular storage temperature. The Marsh grapefruit used in the present test were picked early in their season of maturity, February 6, and as shown by the very small amount of pitting had good vitality. The fruit was stored 8 weeks, a much longer period than normally considered safe or feasible for Florida grapefruit; yet a curing effect was plainly evident in fruit stored for 1 week at 50° F. before transfer to a lower temperature. Not only was the percentage of decay upon removal of the boxes from storage equal to or only slightly higher than that in fruit stored continuously at 32° but decay was less at the end of the holding period. Another beneficial effect of the short storage at 50° was in reduction of surface browning which is typically prevalent on fruit stored long periods at 32°.

**Test 5.** Little pitting developed in Marsh grapefruit during 6 weeks of storage or the subsequent holding period although 1 to 4 percent severe aging was found (table 8). Decay upon removal of the boxes from storage ranged from none in the continuous 32° F. storage to 22

(Continued on page 35)

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# Florida Citrus Exposition Winter Haven Feb. 15-22

The estimated 250,000 persons who will visit the 1958 Florida Citrus Exposition at Winter Haven Feb. 15-22, will see "indisputable proof" that the Sunshine State produces the world's finest oranges, grapefruit and tangerines, Winston Lawless, president of the industry-sponsored show said recently.

Lawless revealed the Exposition, with the cooperation of Florida Citrus Mutual, is attempting to expand its annual fresh fruit contest to attract a record-breaking number of entries seeking the many awards and ribbons which will be awarded.

"We are now getting pledges of entries of the nine commercial varieties from the seven citrus commission districts, and it is indicated that the December freeze has encouraged growers to join with the Exposition in putting our top quality fruit on display," Lawless said.

There will be a grand prize or "best in show" box picked for the top award, a silver trophy to be presented by the Florida Agricultural Research Institute with headquarters in Winter Haven. There will be a top box picked from each district as well as winners in the several variety classifications.

"Some people in our nationwide markets believe that we lost all or most of our good citrus in the December freeze, and the 1958 Exposition hopes to show the public that we can still meet the demands for top quality oranges, grapefruit and tangerines," Lawless said.

While single strength and concentrated citrus juices, along with the sections and salad packs consume the larger portion of the Florida citrus crop, Exposition officials, in planning the fresh fruit contest, realize the necessity of keeping all channels of distribution open so that maximum consumption can be exploited, the Exposition president commented.

The processing segment of the industry will have its big day on Tuesday, Feb. 18, with a special luncheon to be held at noon in Nora Mayo auditorium of the Florida citrus building. Merchandising of the big Florida crops will be the keynote for the day with Charles G. Mortimer, president of General Foods Corp., recently named "the merchandising man of the year" scheduled as the principal speaker. W. W. "Bill" Giddings, local processing official, is the chairman of the committee in charge of the program.

Pictured above is a display of exotic fruit which will be displayed at the Florida Citrus Exposition in Winter Haven, Feb. 15 through Feb. 22. The fruit was supplied by the U. S. Department of Agriculture sub-tropical fruit station in Orlando.

A graphic demonstration of the part that today's youth will play in the future growth of the big Florida citrus industry will be featured during the 1958 Exposition.

Lawless said that a tri-county unit of the citrus division of Florida 4-H clubs, representing, Polk, Highlands and Hardee counties, would cooperate in preparing and maintaining the comprehensive exhibit which will show the progress that 4-H members interested in citrus, have made since the project was first launched at Camp McQuarrie two years ago.

The Exposition is providing 40 front feet of display space in which the citrus men of the future will show trees in various stages of growth from seedlings to budded varieties of producing size.

The 4-H exhibit will be placed adjacent to the junior fresh fruit packing unit which will also be in operation during the Exposition, showing how Florida's fresh oranges, grapefruit and tangerines are packed for commercial shipment. This junior packing house has proved to be a big drawing card for out-of-state visitors to the show.

Cooperating with the Florida Nurserymen's Association, the 4-H boys will use popular Florida ornamental shrubbery as the background for their citrus exhibit, all arranged in what Lawless describes as "a setting of tropical splendor."

Fred P. Lawrence, citriculturist of the University of Florida is serving as advisor to the 4-H clubbers in setting up the special exhibit and will coordinate the project.

The Florida citrus industry must depend on its younger people to carry on the business of producing and merchandising top-quality oranges, grapefruit and tangerines, and this cooperative exhibit during the 1958 Florida Citrus Exposition will show the public that citrus is a prominent part of the state's agriculutral economy," Lawless said.

---

Cold damage to the huge Florida citrus crop over the past few weeks will not interfere with or cause any

disruption in plans for the 1958 Florida Citrus Exposition in Winter Haven, Feb. 15-22. Winston Lawless, president of the citrus-industry sponsored show, said in response to inquiries.

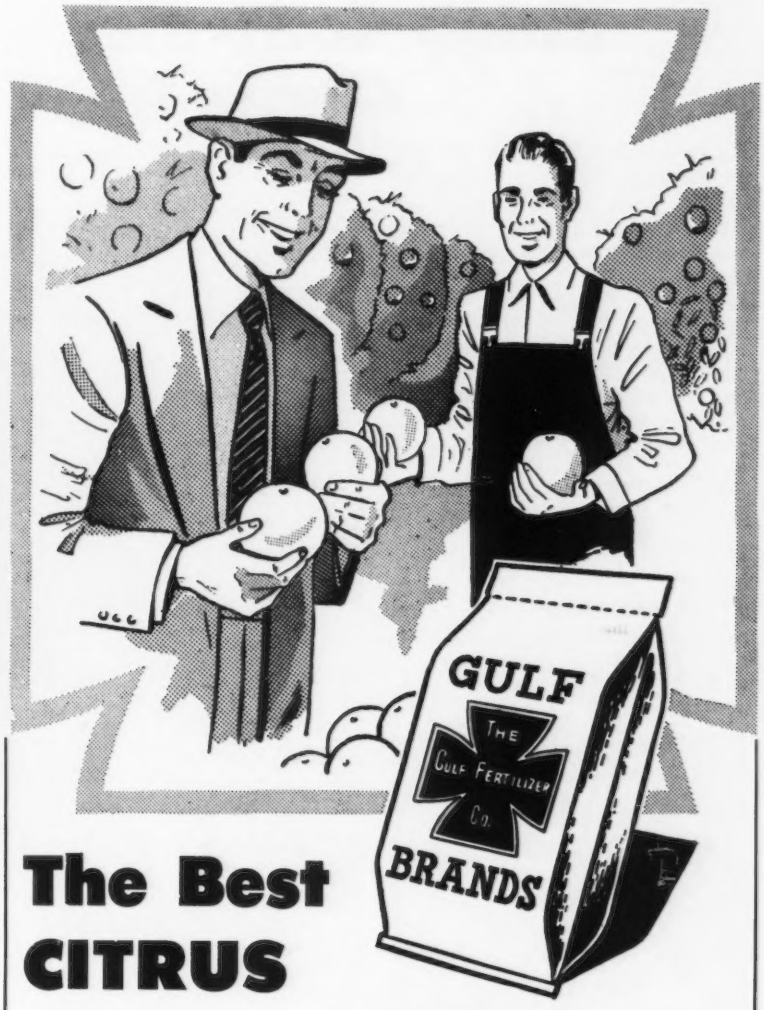
"Fortunately, Mother Nature has left Florida in a good, competitive position citrus-wise and we have an important job to do in the fields of merchandising and sales promotion," Lawless commented. "The Exposition was originally designed to show

WINSTON LAWLESS
PRESIDENT FLORIDA CITRUS
EXPOSITION

the public the fine citrus, both fresh and processed, which Florida produces and we hope through the 1958 show to clearly demonstrate to many thousands of visitors from all over the country that Florida is still very much in the citrus picture."

"Dancing Waters," an attraction hailed as a fabulous fountain spectacle, and which has played to more than 15 million people, following its debut at Radio Music Hall, in New York several years ago has been contracted as the nightly feature to be presented in the high Lake Silver ampitheatre. Multi-colored lights play on huge fountains of water synchronizd with appropriate music and all controlled electronically. In commenting on the signing of "Dancing Waters," Lawless said this would probably be its first appearance against an actual backdrop of water — Lake Silver.

**Keep advised as to remedies for your citrus problems by reading The Citrus Industry magazine.**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# Zineb Controls Citrus Rust Mite

. . . by . . .
ROGER B. JOHNSON, JOHN R. KING AND J. J. McBRIDE, JR.
FLORIDA CITRUS EXPERIMENT STATION, LAKE ALFRED

In 1885, H. G. Hubbard (1) substantiated and expanded the observations of Moore (2, 3) when he presented evidence that the citrus rust mite **Phyllocoptruta oleivora** (Ashm.) was the cause of rust or russet of citrus fruit. Hubbard also reported that this mite could be controlled with flowers of sulfur. Since that time, some 72 years, russet of citrus fruit has been successfully prevented whenever the citrus rust mite was kept under control with some form of sulfur. In 1957, Fisher (4) reported that "——A July application of zineb may prevent fruit russet as well as sulfur ——", and suggested that a fungus rather than rust mite might be the cause of russetting.

The possibility that rust mite might have been controlled with zineb/1 was not mentioned. In a later report (5), however, it was stated that rust mite populations were low seven

DR. JOHN R. KING
INDIAN RIVER FIELD LAB.
CITRUS EXPERIMENT STATION

months after application of zineb while in a third and still later paper, Fisher (6) reported, "On November 17, 1956, the rust mite population on zineb-sprayed Duncan grapefruit trees

DR. R. B. JOHNSON
CITRUS EXPERIMENT STATION
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was 0.93 percent, whereas an oil-parathion sprayed fruits the rust mite population was 41.3 percent. Since no data was available to indicate the rust mite populations during the seven months following application of zineb, since russet has long been controlled by sprays timed to control rust mite, and since there is no evidence that russet occurs in the absence of rust mite, it seemed to these writers that zineb very likely controlled the citrus rust mite. For these reasons, a number of experiments were instituted to determine whether citrus rust mite could be controlled by zineb and related materials. This paper presents the results to date in these experiments.

### Methods

All treatments in all experiments were applied with a conventional hydraulic grove sprayer drawn and powered by a tractor. This sprayer was equipped with two double Royce guns and operated at 600 to 800 psi at the pump. All sprays were applied in brushing-type applications applied to the point of run-off with no effort made to secure coverage of limbs and inside foliage.

The density of citrus rust mite populations on leaves or fruits before spraying and at intervals after spraying was determined for each plot in the following manner: one lens field on the unexposed surface of leaves or fruit and a similar field on the exposed surface were examined for live rust mites with a 10x hand lens. If one or more live rust mite occurred in a lens field, the leaf or fruit was considered infested. In this manner, percentage of leaves or fruit infested with rust mite was determined for each plot. The number of leaves or fruit examined was varied with tree size and number of trees per plot;

DR. J. J. McBRIDE, JR.,
CITRUS EXPERIMENT STATION
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but in general, on mature trees, sample size was standardized at 25 fruit and/or 25 leaves per tree.

/1 A formulation of zinc ethylene bisdithiocarbamate.

Florida Agricultural Experimental Station Journal Series No.....

/1 A formulation of an ester of glycerol manniton laurate. Supplied by Niagara Chemical Division, Food Machinery and Chemical Corporation.

### Zineb Is Effective Without A Wetting Agent

Sprayspread/1, a wetting agent, was used in sprays reported by Fisher (4, 5, 6), but no data was presented to show whether this material had any effect on citrus rust mite. The first experiment was thus designed not only to evaluate zineb against citrus rust mite, but also to determine whether Sprayspread or the combination of zineb plus Sprayspread had any effect on this mite.

The first sprays were applied December 11, 1956. By the end of January, in spite of a marked increase on unsprayed trees, control of rust mite on foliage on trees sprayed with zineb or sulfur was nearly perfect. Sprayspread alone was found worthless and did not enhance the efficiency of zineb.

During the latter part of January, both purple mite, **Metatetranychus**

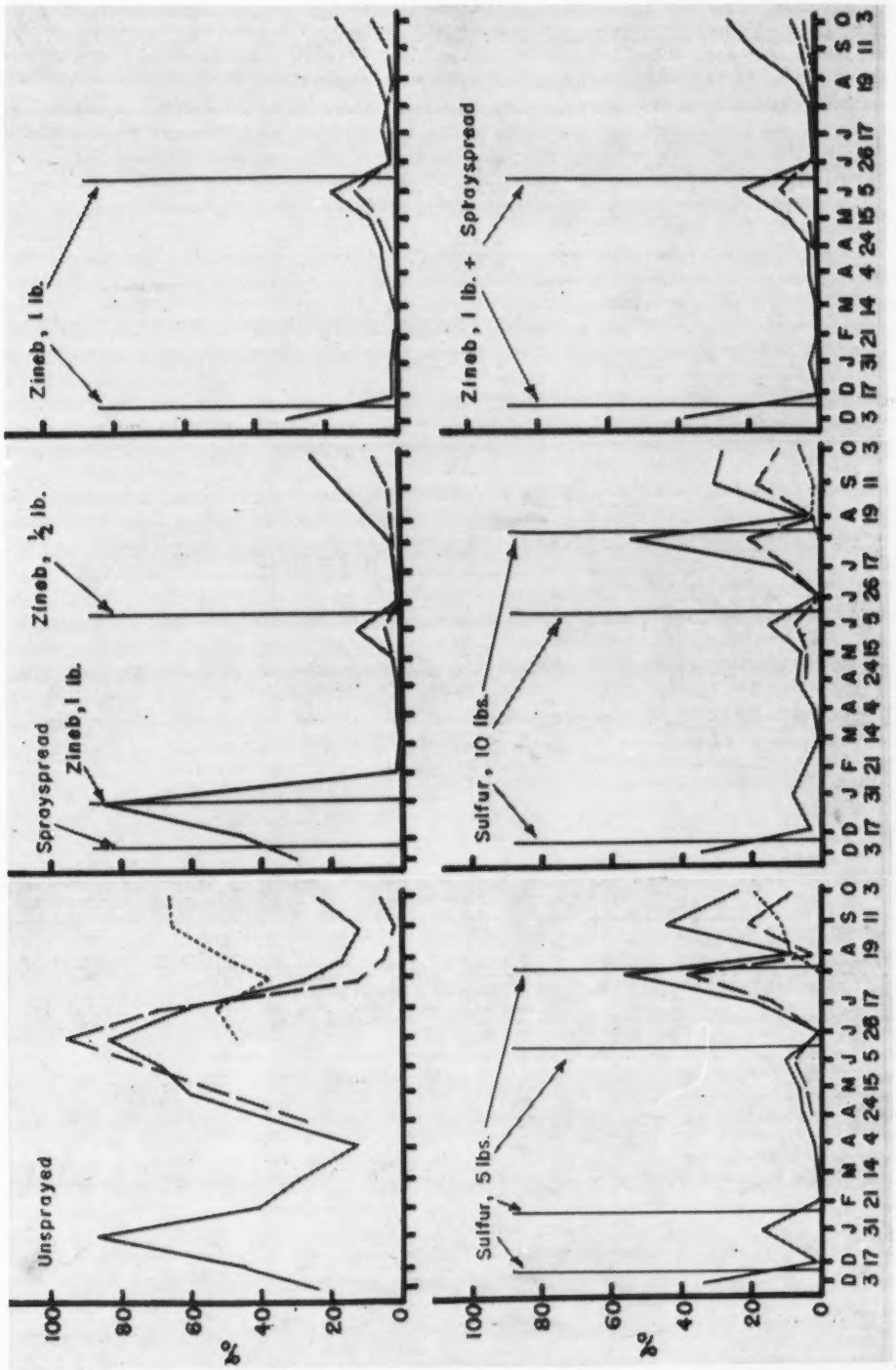



Figure 1. Percentages of leaves (—) and fruit (-) infested with citrus rust mite and percent russetted fruit (....) on Valencia orange trees sprayed with wettable sulfur, zineb, zineb plus Sprayspread or Sprayspread. Vertical lines show dates of application.

citri (Mc G.) and Texas citrus mite, **Eutetranychus banksi** (Mc G.) became sufficiently numerous in all plots to make control measures advisable. Systox was selected for this purpose because unpublished data have shown that it will not control citrus rust mite. Zineb was used with Systox on plots formerly sprayed with Sprayspread while wettable sulfur at 5 pounds per 100 gallons was used with Systox where this material at this dosage had been applied in the first application. Citrus rust mite populations decreased on check trees after the application of Systox and until after bloom. During this interval, there was no increase on any of the sprayed trees. As populations increased on untreated trees after bloom, they also increased at an equal rate in all treated plots. By June 5, 1957, all rust mite treatments had to be reapplied. Scale insects were also becoming numerous, so parathion sprays with sulfur or zineb were applied on June 19, 1957.

Rust mite populations reached a peak on unsprayed trees about June 26, and then declined through September. During this interval very interesting differences developed between trees sprayed with sulfur and those sprayed with zineb. There was a marked increase on sulfur-sprayed trees that resulted in small amounts of russet fruit and made respraying necessary by August. No such increase occurred on any of the zineb-sprayed plots whether sprayed with zineb at 1 pound per 100 gallons, zineb at the same dosage plus Sprayspread, or with 1/2 pound of zineb.

The results of this experiment are

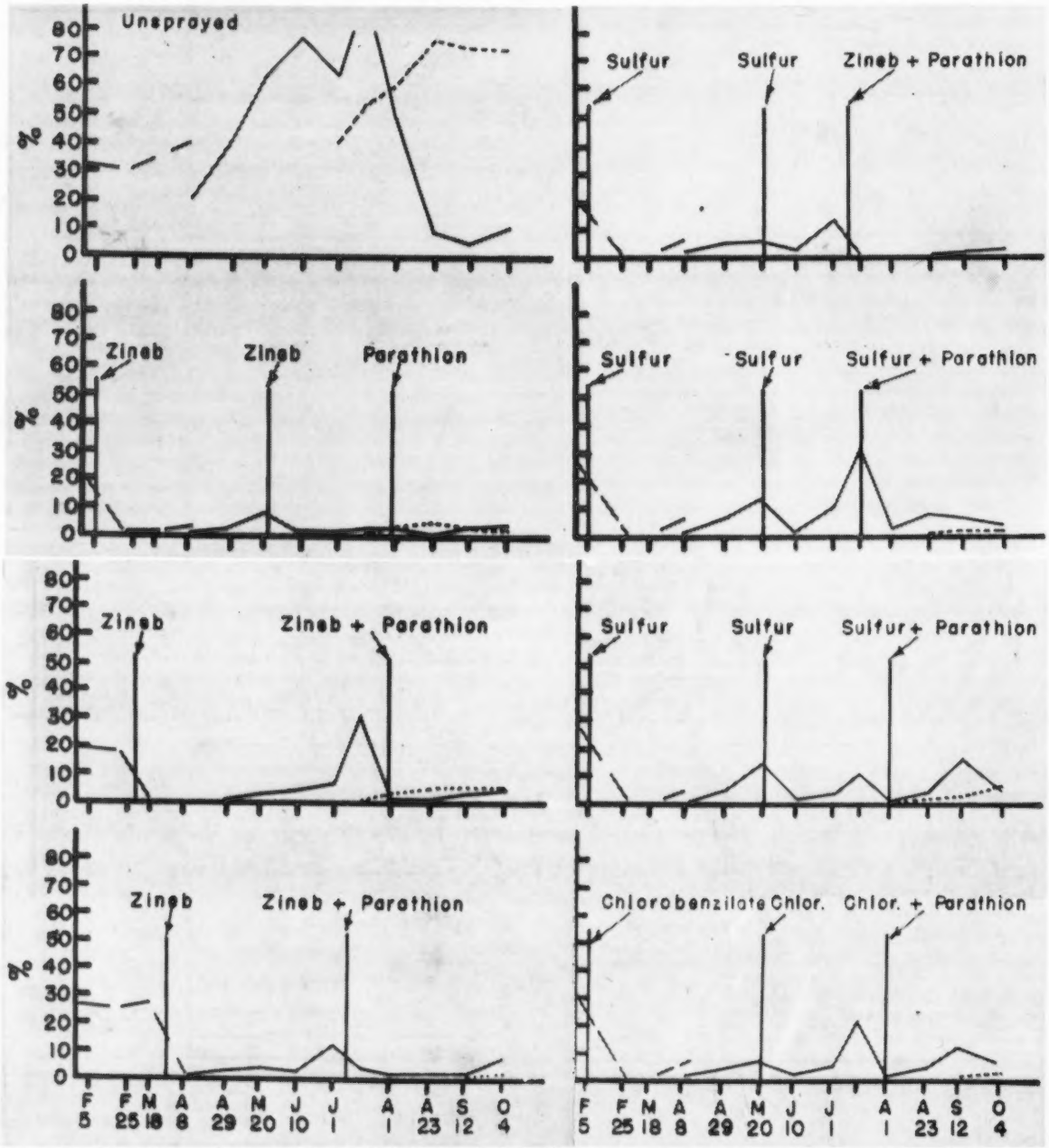



Figure 2. Percentages of leaves (–) and fruit (—) infested with citrus rust mite and percent russetted fruit (....) on Valencia orange trees sprayed with zineb at different times. Verticle lines show dates of application.

presented in Fig. 1. These data demonstrate the following: 1) from December 11, 1956, through October 1, 1957, an interval of 10 months, citrus rust mite was adequately controlled with two applications of zineb while poorer results were obtained with three applications of wettable sulfur at 10 pounds per 100 gallons, or four applications at 5 pounds; 2) Sprayspread had no effect on rust mite and was not needed in zineb sprays; 3) there was no difference between 1/2 and 1 pound of zineb applied when rust mite populations were increasing; 4) zineb gave a slightly slower kill than wettable sulfur; and 5) zineb was equally effective in combination with parathion or Systox.

### Zineb Kills Citrus Rust Mite

During March of 1957, laboratory experiments were conducted to determine whether zineb killed citrus rust mite or repelled them. Heavily infested Pineapple orange leaves were brought into the laboratory where some were dipped in zineb suspensions and some were left untreated. All leaves were held on moist filter paper in petri dishes and observed daily with a microscope. Zineb did not repel the rust mites, but killed them. Rust mite eggs hatched in the presence of zineb, but the young mites soon died.

### Control of Citrus Rust Mite With Various Amounts of Zineb, Maneb or Cholorobenzilate

Shortly after the start of Experiment 1, it was discovered that maneb/1 would kill citrus rust mite

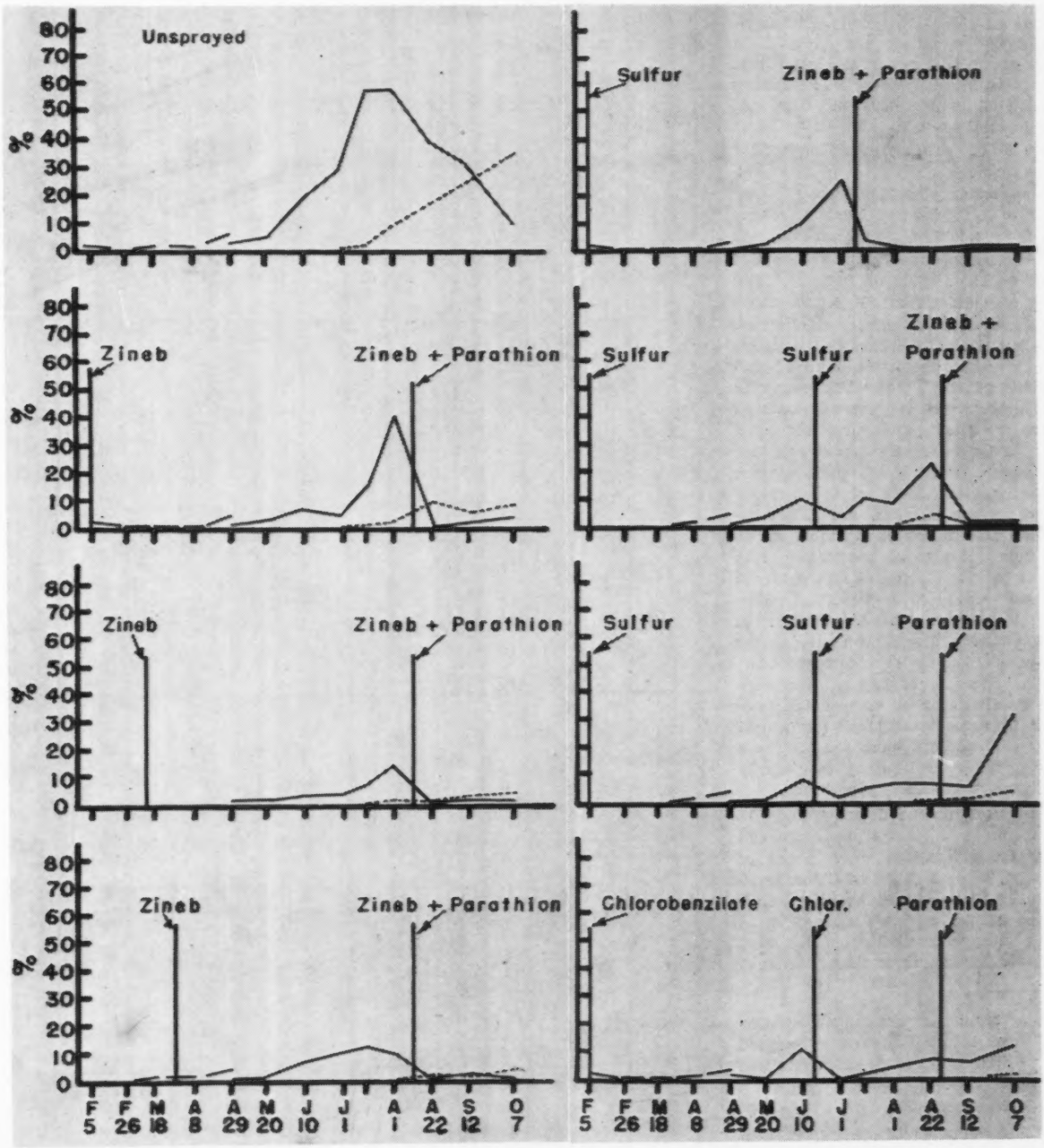



Figure 3. Percentages of leaves (-) and fruit (—) infested with citrus rust mite and percent russetted fruit (....) on Valencia orange trees sprayed with zineb at different times. Vertical lines show dates of application.

as well as zineb. Prior to that time, Jeppson et al (7) reported that chlorobenzilate/1 showed promise in the control of citrus rust mite. An experiment was designed to compare several dosages of these promising materials with wettable sulfur against citrus rust mite.

Experimental treatments were first applied on January 24 and 25, 1957, and there was no rain for nine days after application. Nearly perfect control was obtained with all dosages of zineb, maneb, chlorobenzilate and wettable sulfur for about 81 days and none of these treatments needed respraying for about 123 days. Data presented in Table 1 also show that on May 27, 1957, there was no significant difference between 10 pounds of wettable sulfur and 1/2 or 1 pound of either zineb, maneb, or chlorobenzilate. Ten pounds of wettable sulfur was significantly superior to 1/4 pound of zineb or maneb and 5 pounds of wettable sulfur.

The second application was applied to the same plots on May 28, 1957. On May 29, a rainfall of 0.17 inches occurred and 1.17 inches on May 30. In addition, 0.86 inches fell on June 1, 2, and 4, making a total of 2.20 inches during the week following application. It is generally believed that the effectiveness of sulfur is reduced by rain. If this is so, data presented in Table 2 indicate that rain has less effect on the performance of maneb, zineb and chlorobenzilate than it has on wettable sulfur. Within 20 days of application, rust mite populations needed respraying on trees sprayed with wettable sulfur. After 41 days, wettable sulfur was significantly poorer than all dosages of zineb, maneb, or chlorobenzilate.

On July 15, 1957, all plots were sprayed with an oil emulsion containing 1.3 percent actual oil for control of scale insects, purple and Texas citrus mite. This spray temporarily reduced rust mite populations.

This experiment demonstrated: 1) that sprays of ½ or 1 pound of zineb per 100 gallons, ½ or 1 pound of maneb, ½ or 1 pound of Chlorobenzilate or 10 pounds of wettable sulfur were equally effective against citrus rust mite when applied in January; 2) that 1/4 pound of zineb or maneb were equally as effective as 5 pounds of wettable sulfur applied in January; and 3) that zineb, maneb, and chlorobenzilate were all superior to wettable sulfur applied in May.

### Timing of Zineb Sprays

Three experiments, one at Fort Pierce on Pink Seedless grapefruit and two at Lake Alfred on Valencias, were conducted to determine the time to apply zineb sprays for optimus control of the citrus rust mite. The two experiments at Lake Alfred differed when started in February of 1957, in that one, a grove referred to as the Adams Grove, had a moderate infestation of citrus rust mite, while the other, called the Fletcher Grove, was nearly free of citrus rust mite.

Data from the Adams Grove are shown in Fig. 2. Here citrus rust mite remained at moderate levels

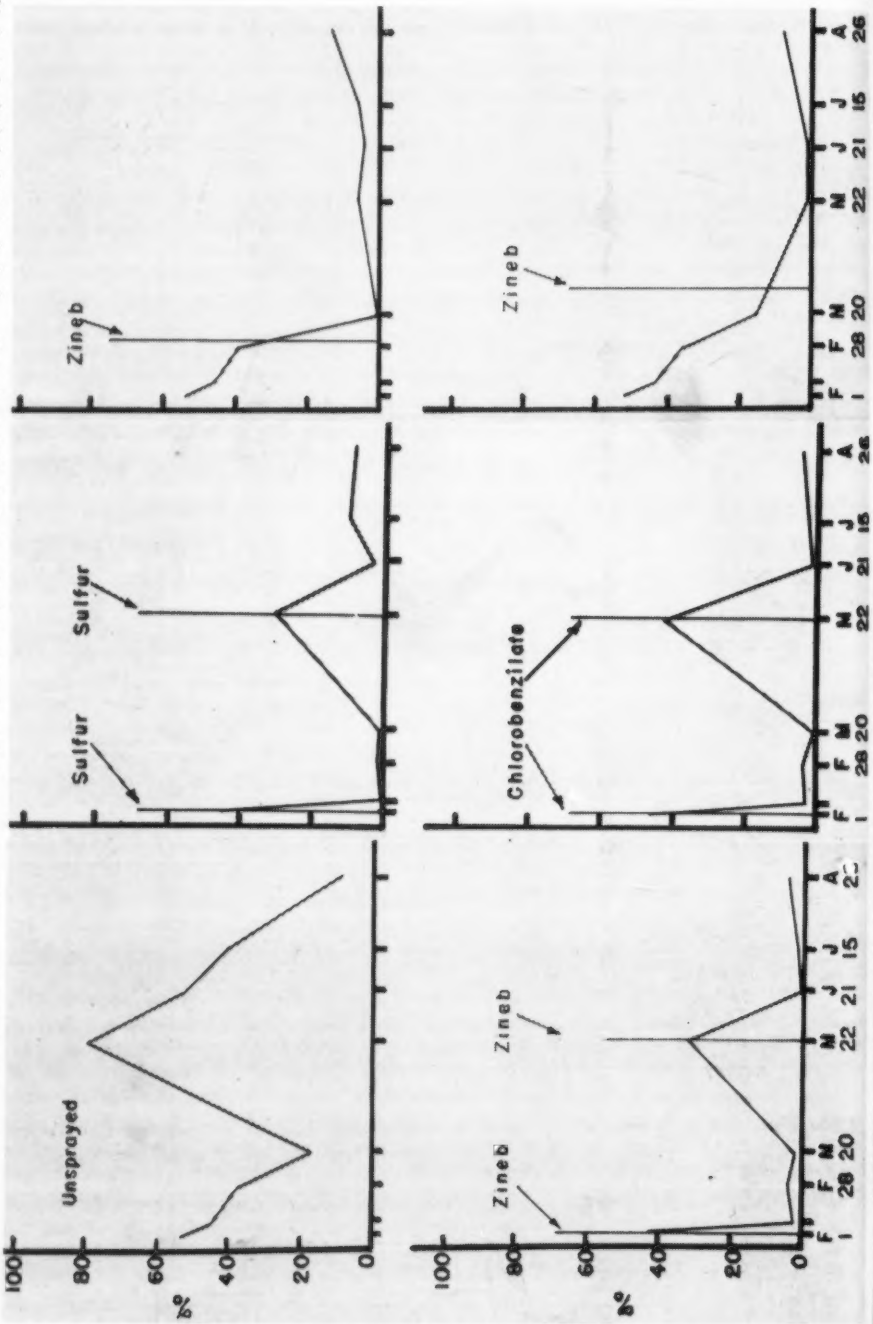



Figure 4. Percentages of leaves infested with citrus rust mite on pink seedless grapefruit trees sprayed with zineb at different times. Vertical lines show dates of application.

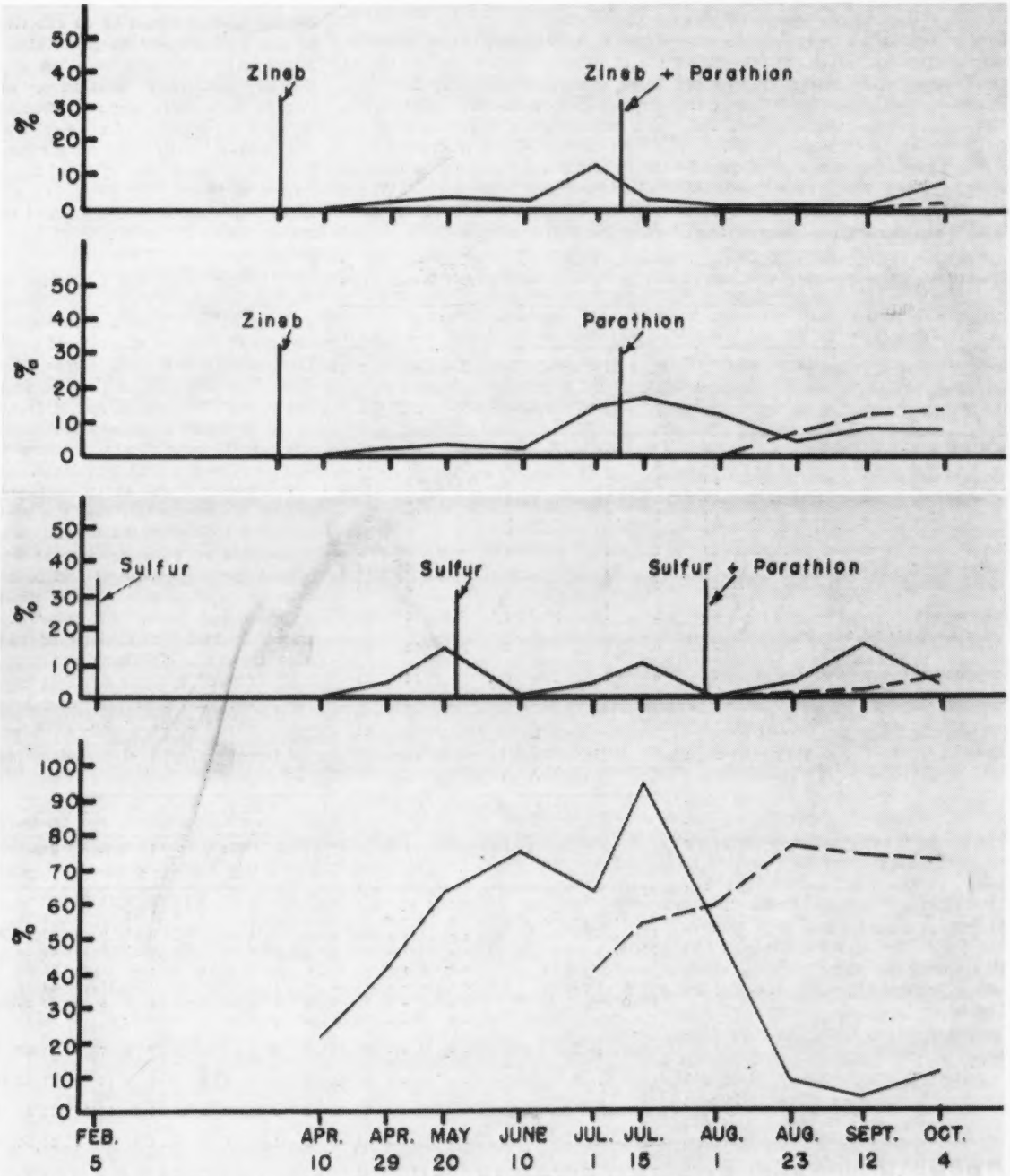
/1 A formulation of manganese ethylene biddithiocarbamate supplied by E. I. DePont de Nemours and Company.

/1 A formulation of ethyl 4, 4' Dichlorobenzilate supplied by Giegy Company, Inc.

through February and March, but increased rapidly on new fruit and foliage from April through July and then declined from July to October. Under these conditions, sprays containing zineb at 1 pound per 100 gallons, wettable sulfur at 10 pounds, or chlorobenzilate at 1 pound, applied on February 5, less than a month before bloom, controlled rust mite until late May or mid-way between the post-bloom period and time for the July scalicide application. Where zineb was delayed until full-bloom on March 11, or post-bloom on March 28, control lasted until July. Where an application of sulfur was applied in February and the use of zineb was delayed until July, it was necessary to use sulfur in May.

The results of this experiment show that regardless of time of application; two applications of zineb; two applications of wettable sulfur plus an application of zineb; three applications of wettable sulfur; or three applications of chlorobenzilate were needed to control rust mite from January to October.

The results of the timing experiment in the Fletcher grove are shown in Fig. 3. Here there were very few citrus rust mite on unsprayed trees from February through April, but populations increased from April through July and then declined slow-




Figures 5, 6, 7, and 8. Percentages of fruit infested with citrus rust mite (—) and percent russetted fruit (–) on trees sprayed twice with zineb (Figure 5), trees sprayed once with zineb (Figure 6), trees sprayed with sulfur (Figure 7) and unsprayed trees (Figure 8). Vertical lines show dates of application.

ly through September. Under these conditions, a February zineb spray applied less than a month before bloom lasted until July or about a month longer than no spray at all or about as long as wettable sulfur or chlorobenzilate. Full-bloom and post-bloom zineb sprays controlled rust mites until August. Where the use of zineb was delayed until late August, sulfur sprays were needed in February and June.

The results of this experiment show that two applications of zineb, one or two applications of wettable sulfur plus one of zineb, two applications of wettable sulfur or two of chlorobenzilate were needed to control citrus rust mite on fruit and foliage from January to October.

The results of the timing experiment at Fort Pierce are presented in Fig. 4. In this experiment, rust mite populations on unsprayed trees declined from February through March, reached a peak in May and then declined through August. Under these conditions, February applications of zineb, wettable sulfur or chlorobenzilate controlled rust mite until mid-May. Zineb sprays applied during bloom on March 4, and after bloom on April 5, both controlled rust mite into late August. In this experiment there was no detectable difference in rust mite control between zineb, wettable sulfur or chlorobenzilate from January through August.

Although there were distinct differences between experiments in rust mite control with zineb, the length of the interval of control was closely related to the behavior of populations on unsprayed trees. When rust mite was increasing, control was of shorter duration than when populations remained static or were decreasing. These data also showed no consistent advantage to zineb sprays before bloom and the spring flush of growth because wettable sulful sprays usually lasted just as long during this period. Full-bloom, post-bloom, and summer applications of zineb were superior to wettable sulfur.

### Russet Can Occur After Zineb Sprays

In the Adams' Grove experiment, plots that had received zineb after bloom were divided. One-half of the trees were resprayed July 29. Subsequent rust mite population levels and percentages of russetted fruit are shown in Figs. 5-8. Where respraying was done, rust mite was controlled and no rusty fruit resulted. Where rust mite was not controlled, some russeting did develop.

**Table 1. Citrus Mite Control Following Winter Application of Several Dosages of Zineb, Maneb, Chlorobenzilate or Wettable Sulfur to Valencia and Pineapple Orange Trees at Lake Alfred, Florida.**

| Materials and Dosages per 100 Gallons. | Percent Infested Leaves on Indicated Dates Days Before (-) and After (+) Spraying on January 24-25, 1957. | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Jan. 22 (-2) | Jan. 29 (+6) | Feb. 12 (+19) | Mar. 5 (+40) | Mar. 26 (+61) | Apr. 15 (+81) | May 6 (+102) | May 27 (+123) |
| Systox, ¼ pt. (Check) | 40 | 15 | 48 | 61 | 51 | 38 | 56 | 87 |
| Zineb, 1/4 lb. + Systox, 1/4 pt. | 45 | 3 | 1 | 1 | 0 | 4 | 7 | 31 |
| Zineb, 1/2 lb. + Systox, 1/4 pt. | 30 | 1 | 1 | 1 | 0 | 1 | 4 | 12 |
| Zineb, 1 lb. + Systox, 1/4 pt. | 36 | 1 | 1 | 1 | 0 | 0 | 3 | 15 |
| Maneb, 1/4 lb. + Systox, 1/4 pt. | 62 | 1 | 3 | 1 | 0 | 6 | 12 | 28 |
| Maneb, 1/2 lb. + Systox, 1/4 pt. | 49 | 1 | 2 | 1 | 0 | 1 | 6 | 18 |
| Maneb, 1 lb. + Systox, 1/4 pt. | 49 | 1 | 1 | 1 | 0 | 0 | 3 | 6 |
| Thimet, 2 pts. | 42 | 5 | 47 | 51 | 38 | 25 | 45 | 83 |
| Chlorobenzilate 25w, 1/2 lb. + Systox 1/4 pt. | 24 | 1 | 0 | 1 | 1 | 1 | 5 | 15 |
| Chlorobenzilate 25w, 1 lb. + Systox, 1/4 pt. | 41 | 1 | 1 | 0 | 0 | 1 | 5 | 14 |
| Wettable Sulfur, 5 lbs. + Systox, 1/8 pt. | 32 | 0 | 1 | 3 | 1 | 11 | 12 | 34 |
| Wettable Sulfur, 10 lbs. + Systox, 1/8 pt. | 33 | 0 | 1 | 1 | 0 | 1 | 11 | 16 |
| L.S.D. (19:1) | | | | | | | | 8 |
| (99:1) | | | | | | | | 11 |

### Efficiency of Nabam, Nebam plus Zinc Sulfate, and Zineb plus Fixed Copper Against Citrus Rust Mites

After it had been found that zineb would control the citrus rust mite, small scale screening tests were conducted at both Lake Alfred and Fort Pierce to determine whether disodium ethylene biodithiocarbamate hexahydrate (nabam) alone or reacted in the sprayer tank with zinc sulfate to form zinc ethylene biodithiocarbamate (zineb) would be as effective as the commercially prepared zineb. These screening trials were not considered sufficiently conclusive, although there were some differences between treatments. An experiment was designed partly to determine more fully the comparative value of these sprays, and partly to determine the effect of a fixed copper compound on the efficiency of zineb against citrus mites.

This experiment was conducted in a block of mature Pineapple oranges at Lake Alfred. Sprays were applied on May 27, 1957, at the rate of about 1,000 gallons per acre. During the eight days following application, rainfall totaled 2.20 inches and it is believed that this may have materially affected the persistence of some if not all of the miticidal residues.

The results of this experiment, presented in Fig. 9, show that the post-application development of rust mite populations on all sprayed trees was related both to treatment and to development of rust mite populations on unsprayed trees. All sprays resulted in initial reductions of rust mite populations. These reductions were followed by increases that coincided with increases on unsprayed trees and, in turn, by a decline dur-

**Table 2. Citrus Rust Mite Control Following Spring Application of Several Dosages of Zineb, Maneb, Chlorobenzilate or Wettable Sulfur to Valencia and Pineapple Orange Trees at Lake Alfred, Florida.**

| | Percent Infested Leaves (L) and Fruit (F) and Percent Russetted Fruit (R) on Indicated Dates. (Days after Spraying on May 28, 1957.) | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | May 27 | | | June 17 (20) | | | July 8[1] (41) | | | July 29[1] (62) | | | Aug. 13 (77) | | | Sept. 5 | | | Sept 30 | | |
| | L | F | R | L | F | R | L | F | R | L | F | R | L | F | R | L | F | R | L | F | R |
| Unsprayed | 87 | - | - | 97 | - | - | 98 | 99 | 64 | 12 | 18 | 56 | 9 | 11 | 72 | 9 | 11 | 73 | 29 | 30 | 80 |
| Zineb, 1/4 lb. | 31 | - | - | 1 | - | - | 17 | 6 | 0 | 1 | 1 | 0 | 3 | 4 | 0 | 17 | 8 | 0 | 65 | 51 | 1 |
| Zineb, 1/2 lb. | 12 | - | - | 0 | - | - | 18 | 5 | 0 | 1 | 1 | 0 | 1 | 3 | 0 | 21 | 9 | 0 | 63 | 52 | 0 |
| Zineb, 1 lb. | 15 | - | - | 0 | - | - | 7 | 0 | 0 | 1 | 1 | 0 | 1 | 22 | 0 | 11 | 3 | 0 | 43 | 25 | 1 |
| Maneb, 1/4 lb. | 28 | - | - | 2 | - | - | 46 | 18 | 0 | 0 | 2 | 0 | 8 | 4 | 0 | 20 | 19 | 0 | 52 | 50 | 1 |
| Maneb, 1/2 lb. | 18 | - | - | 0 | - | - | 17 | 3 | 0 | 1 | 1 | 0 | 3 | 4 | 0 | 16 | 11 | 0 | 66 | 54 | 0 |
| Maneb, 1 lb. | 6 | - | - | 1 | - | - | 15 | 5 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 9 | 5 | 0 | 47 | 35 | 0 |
| Flowable Trithion, 1 pt. | 83 | - | - | 2 | - | - | 40 | 24 | 0 | 0 | 2 | 0 | 6 | 9 | 0 | 28 | 26 | 0 | 68 | 61 | 1 |
| Chlorobenzilate 25W, 1/2 lb. | 15 | - | - | 1 | - | - | 20 | 14 | 0 | 0 | 0 | 0 | 1 | 3 | 0 | 9 | 7 | 0 | 54 | 50 | 0 |
| Chlorobenzilate 25W, 1 lb. | 14 | - | - | 0 | - | - | 20 | 12 | 0 | 1 | 1 | 0 | 2 | 3 | 0 | 9 | 14 | 0 | 47 | 43 | 0 |
| Wettable Sulfur, 5 lbs. | 34 | - | - | 28 | - | - | 78 | 88 | 1 | 3 | 11 | 8 | 3 | 16 | 12 | 18 | 14 | 10 | 54 | 53 | 8 |
| Wettable Sulfur, 10 lbs. | 16 | - | - | 13 | - | - | 46 | 49 | 0 | 1 | 2 | 0 | 3 | 9 | 4 | 17 | 16 | 1 | 54 | 51 | 6 |
| L.S.D. (19:1) | 8 | | | 2 | | | 8 | 23 | | 2 | 2 | | ns | 4 | | ns | 5 | | 9 | 10 | |
| (99:1) | 11 | | | 3 | | | 11 | 31 | | 3 | 2 | | ns | 5 | | ns | 7 | | 12 | 13 | |

[1] All trees sprayed July 15, 1957, with 1.3% actual oil.

ing July on all sprayed as well as unsprayed trees. Differences between treatments were in the rapidity of recovery of rust mite populations, the severity of the infestation before the natural decline took place, and the resultant amount of rust mite injury to fruit.

These differences show: 1) that zineb gave the best control; 2) that this control was reduced by the addition of copper; and 3) that nabam, wettable sulfur, and nabam plus zinc sulfate were increasingly inferior to zineb in that order.

### Thorough Application of Zineb Is Needed for Good Rust Mite Control

Although no variation in thoroughness of application was attempted, it is believed that thorough coverage of all fruit and leaf surfaces are needed for optimum rust mite control with zineb. This is borne out by the fact that rust mites have not been eliminated on untreated portions of partially-treated tagged fruit. Efforts to determine whether rust mite are repelled by zineb have shown no repellent action. On the contrary, rust mites crawl freely through zineb residues and are killed only in the presence of zineb. Rust mite eggs hatch in the presence of zineb, but the larvae do not develop and soon die.

### Persistence of Zineb Residues

Citrus foliage from trees sprayed with zineb, zineb plus oil and zineb plus parathion was analyzed for zineb at varying times after application to determine the persistence of the zineb residues. The sprays were applied in the early summer using 1 pound of zineb per 100 gallons. Oil was used at 1.3 percent and parathion at 1 2/3 pounds of 15 percent wettable powder per 100 gallons.

The results of the analyses are shown in Fig. 10. Initial deposits of zineb were slightly higher when used with oil than when zineb was used alone or with parathion. The most important point to be noticed, however, is the slopes of the three curves. Zineb with oil persisted much longer than zineb with parathion and this latter combination persisted somewhat longer than zineb alone. Half-lives of zineb alone and in these combinations can be calculated from the curves and are found to be: zineb, 9 days; zineb-parathion, 13 days; zineb-oil, 21 days. An indication of what this means in terms of relative deposits can be seen by following the curves to the right. After 49 days, 0.1 mcg. of zineb per square cm. remained when used alone, while it required 68 days for the zineb-parathion combination to reach this value. After 70 days, with the oil combination, there was still nearly 0.5 mcg. zineb per square cm. of leaf surface.

### Summary

Preliminary results from six experiments with zineb and other materials at Lake Alfred and Fort Pierce have shown that citrus rust mite may be controlled from December through October more effectively with zineb than wettable sulfur. However, seasonal differences were noted. Zineb sprays applied before bloom in December, January, and February were

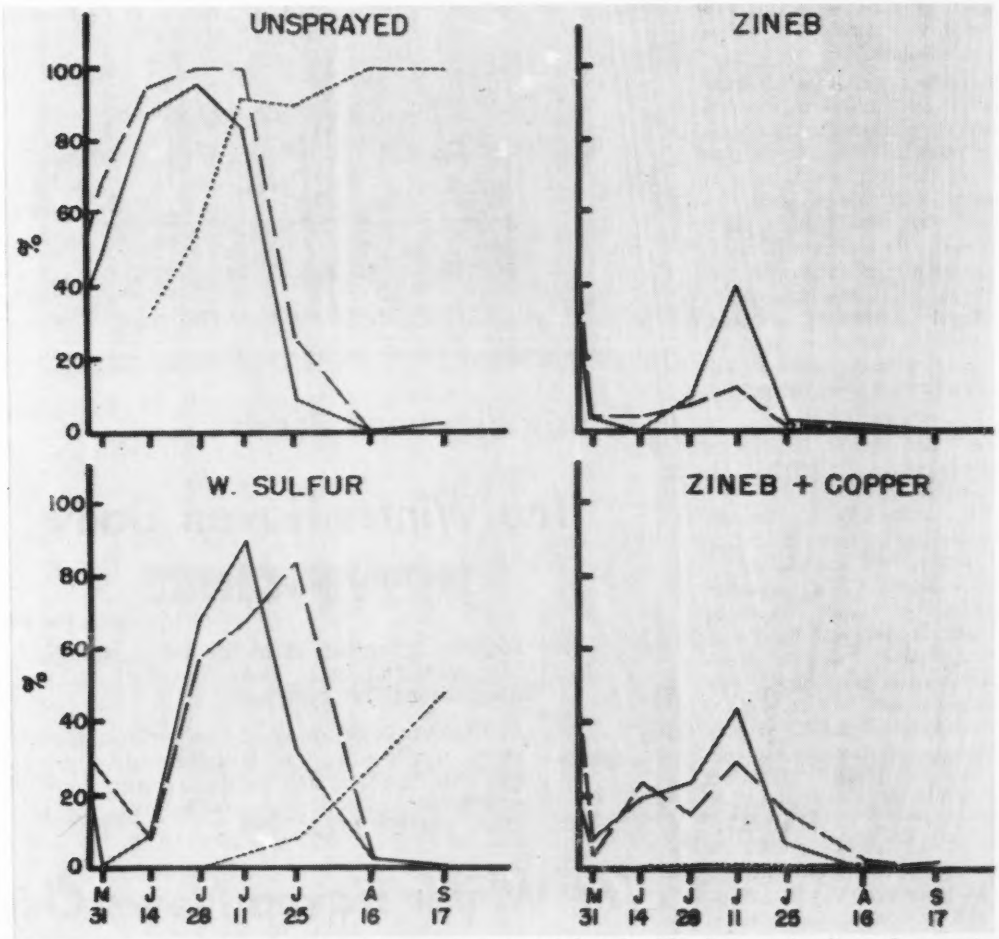



Figure 9. Percentages of leaves (--) and fruit (—) infested with citrus rust mite and percent russetted fruit (....) on Pineapple orange trees sprayed with sulfur, zineb, zineb plus copper, nabam or nabam plus zinc sulfate. (See balance of figure on next page.)

more effective than wettable sulfur, whereas zineb was far more effective than wettable sulfur after bloom during the spring and summer months.

No significant difference could be detected between 10 pounds of wettable sulfur and 1/2 or 1 pound of zineb, 1/2 or 1 pound of maneb or 1/2 or 1 pound of chlorobenzilate applied in January. Dosages of zineb or maneb as low as 1/4 pound per 100 gallons or 1/2 pound of chlorobenzilate applied in May were superior to wettable sulfur. These facts should be considered closely when the economics of rust mite control are studied. It is believed that dosages of zineb in excess of 1/2 pound per 100 gallons are superfluous and unnecessarily expensive.

Nabam should not be used on citrus without zinc sulfate because it may cause a severe burn and is less effective than zineb or wettable sulfur. When reacted with sinc sulfate, it is as good as wettable sulfur, but inferior to zineb. Poorer rust mite control should be expected where copper is used with zineb than where zineb is used alone.

Zineb residues on foliage are quite persistent, especially when zineb is used with oil emulsions and in spite of heavy rainfall. This may in part account for the long period of rust mite control with this material.

Although much remains to be learned about rust mite control with zineb, it is believed that zineb may be profitably used in post-bloom sprays when copper compounds are not needed and in summer scalicide sprays. The value of zineb in fall applications has not been determined.

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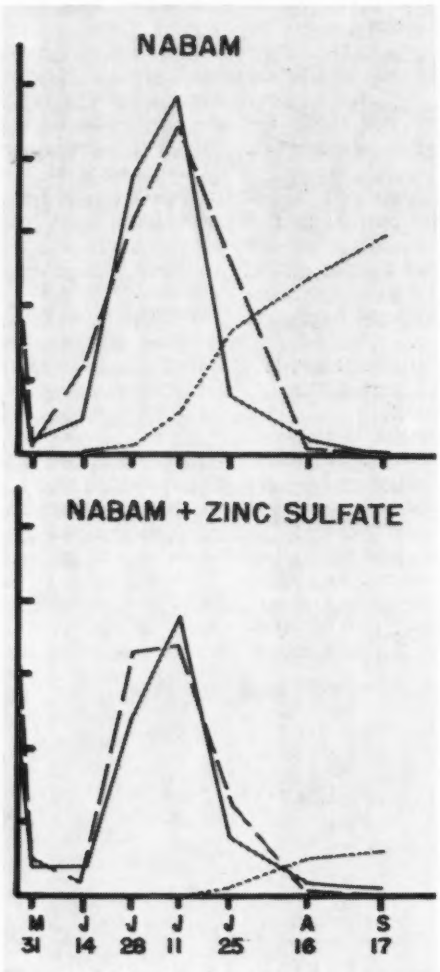


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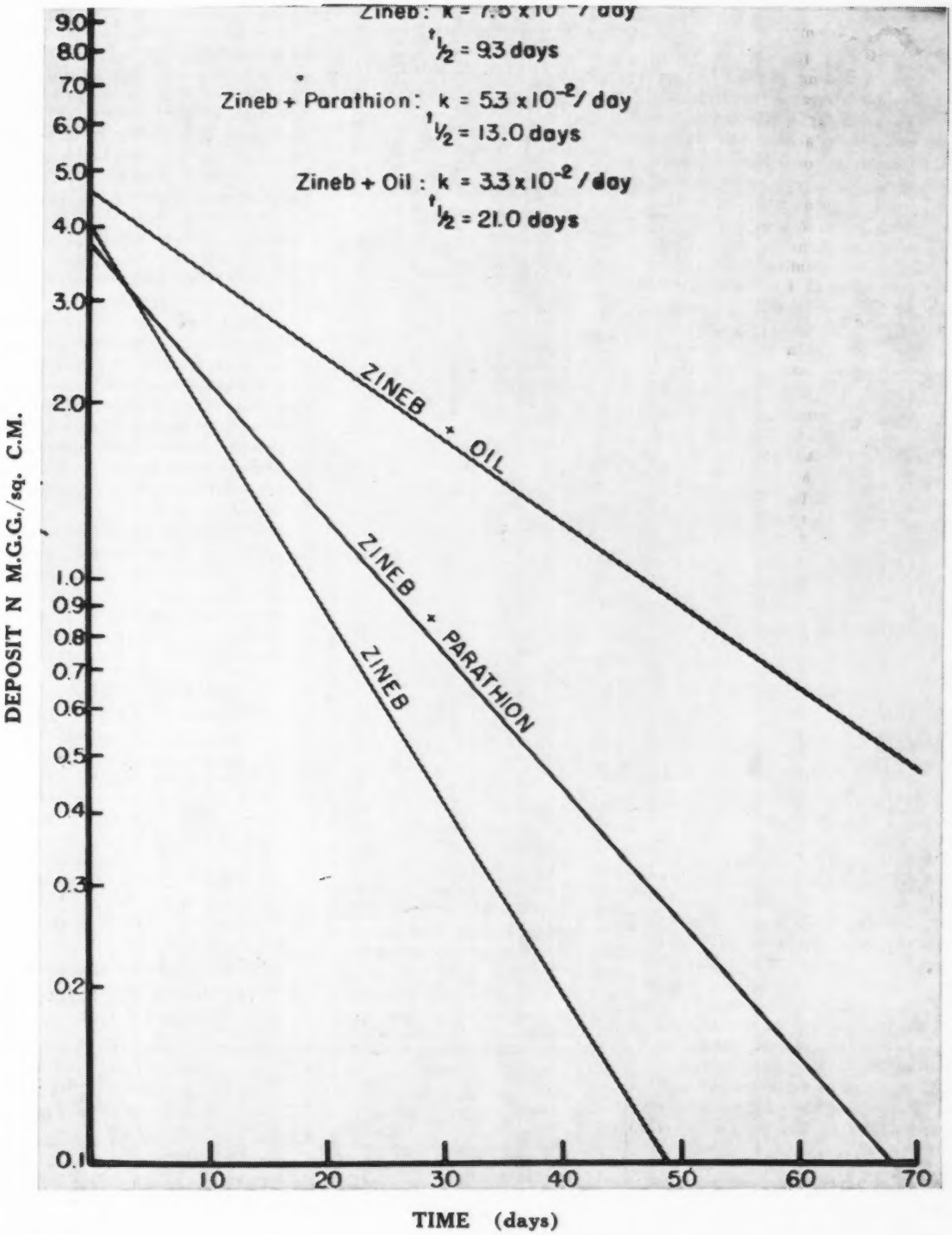
Zineb : k = 7.5 x 10 -7 day
t½ = 9.3 days
Zineb + Parathion : k = 5.3 x 10-2 / day
t½ = 13.0 days
Zineb + Oil : k = 3.3 x 10-2 / day
t½ = 21.0 days
ZINEB + OIL
ZINEB + PARATHION
ZINEB
DEPOSIT N M.G.G./sq. C.M.
9.0
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0.3
0.2
0.1
10
20
30
40
50
60
70
TIME (days)

# Observation of Abnormal Citrus Rootstock Reactions In Brazil

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**Summary**

In a rootstock planting at Tiete symptoms consisting of pegs and an orange-yellow coloration occurred at the bud-unions of 8-year-old clonal Pera sweet orange tops on Florida Rough lemon and on trifoliate-orange rootstocks. Trees composed of the same Pera orange tops on sweet lime or on Rangpur lime showed no xyloporosis symptoms on these rootstocks. In this planting, similar but even more marked bud-union symptoms of indentation into the wood and cracking of the bark were observed on trees with Eureka lemon tops on trifoliate-orange rootstocks.

In the Ribeirao Preto planting xyloporosis symptoms occurred on both sweet lime and Rangpur lime rootstocks with Baia navel orange tops. The inner bark and wood-pitting symptoms on Rangpur lime appeared first and were stronger at the ground level and developed upward toward the union.

Association of abnormal symptoms at the bud unions of sweet orange tops on Florida Rough lemon rootstock with xyloporosis and cachexia and the indicated differences in causal agents are discussed in relation to the observed rootstock reactions in Brazil.

## INTRODUCTION

Since 1947 the Instituto Agronomico, Campinas, Brazil, and the United States Department of Agriculture have cooperated on investigations of the virus diseases of citrus, principally the disease caused by tristeza virus. In citrus areas where tristeza virus spreads rapidly tristeza-tolerant rootstocks must be used. With the utilization of new rootstocks in commercial plantings in Brazil the presence or absence of other viruses in old-line colonial sources of budwood has assumed importance. The tristeza-tolerant Rangpur lime was used as a rootstock in extensive commercial plantings and in experimental ones, but it soon showed symptoms of bark shelling and gum spots that Moreira (9) demonstrated to be caused by exocortis virus. Association of bark-shelling symptoms on Rangpur lime rootstock with exocortis virus was subsequently reported by Olson and Shull (10) in Texas and by Reitz and Knorr (12) in Florida. Since other diseases such as cachexia or xyloporosis could limit the commercial use of different varieties as rootstocks in Brazil, the need arose to determine whether cachexia and xyloporosis are caused by the same or different viruses.

Xyloporosis was first described by Reichert and Periberger (11) as a disease of sweet orange on sweet lime rootstock. Cachexia was described by Childs (1) as a disease of Orlando tangelo and later (2) he pointed out the similarity of bark symptoms of cachexia to those of xyloporosis. Grimm et al., (6), described a bud-union abnormality of sweet orange on Florida rough lemon rootstock. Upon removal of the bark at the bud union they found a dotted to continuous line of orange-yellow discoloration on the inner bark surface associated with rounded protrusions and pegs that extended from the bark into corresponding depressions in the wood. They suggested that the bud-union abnormality might be due either to genetic incompatibility or to a virus such as that causing cachexia. Marked symptoms of the bud-union disorders were not observed in all sweet orange trees on rough lemon, in any trees having grapefruit tops and rough lemon rootstock, or in any sweet orange trees on sour orange rootstocks. More extensive observation on the reactions of these scion-rootstock combinations were reported by Childs et al., (4), together with data association of the abnormal bud-union symptoms of sweet orange on Florida rough lemon rootstock with cachexia, as expressed on Orlando tangelo test plants in the budwood certification nursery of the Florida State Plant Board. On the basis of similarity of bark symptoms and transmission tests by Childs (3), cachexia and xyloporosis were considered to be caused by the same virus and the name xyloporosis was adopted (4).

Olson and Shull (10) in Texas made transmission tests from a Marsh white grapefruit tree on a Rangpur lime rootstock that showed xyloporosis symptoms and obtained symptoms of xyloporosis on sweet lime and symp-

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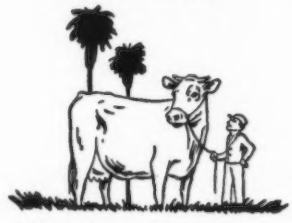

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toms of xyloporosis (cachexia) on tangelos. Olson and Shull employed the term xyloporosis as synonymous with cachexia but Olson expressed the opinion that more definite evidence was needed to prove that the causal agent of these two diseases were the same.

## OBSERVATIONS IN CITRUS PLANTINGS

### Tiete Rootstock Planting

The 8-year-old citrus planting at Tiete is on the grounds of a sub-station of the Instituto Agronomico of Campinas. The observations are reported in Table 1. The value of the comparative readings is greatly enhanced by the fact that all buds used for each variety top came from single-tree sources.

The occurrence of bark-shelling symptoms of exocortis virus on trifoliate-orange rootstock and of similar but less prominent symptoms on Rangpur lime rootstock with Hamlin, Baianinna and Maracana sweet orange tops suggests an identical cause of these disease conditions as noted by Moreira (9). At the same time the lack of any symptoms on sweet lime (Lima da Persia) rootstock with these same tops showed their freedom from xyloporosis infection (7), The presence of psorosis virus in Baianinha and its absence in Hamlin and Maracana oranges did not affect the degree of bark-shelling symptoms of exocortis on the trifoliate orange or Rangpur lime rootstock. The exocortis symptoms began near the ground line and extended upward on the stem, in some cases reaching the bud union 12 to 20 inches above.

The reaction of rootstocks with Pera sweet orange tops were in distinct contrast to those with the other three sweet orange tops tested. The Pera orange top was free of exocortis virus as shown by the absence of bark-shelling on trifoliate-orange and Rangpur lime rootstocks. It was free of xyloporosis as indicated by the absence of symptoms on sweet lime rootstock. That it was free of psorosis virus was indicated by extensive observations on this old clone selection over a period of years at the Limeira Citrus Station. In fact this clonal selection of Pera orange was thought to be free of all viruses, except tristeza virus, which is widespread and considered present in all sweet orange scions, until the abnormal bud-union symptoms of pegs and an orange-yellow ring (Table 1) were found when this Pera orange top was on Florida rough lemon and trifoliae-orange rootstocks.

The abnormal bud-union symptoms on Pera orange on Florida Rough lemon rootstock occurred on all 12 trees in the 4 replicated blocks and were typical of the bud-union abnormality of Rough lemon rootstock with orange scions previously described and associated with cachexia (4, 6). The occurrence of similar abnormal symptoms of pegs, yellow coloration, and some bark cracking at the bud union of Pera orange tops on trifoliate-orange rootstock suggests that this condition might also be due to the same or a similar causal agent The symptoms observed at Tiete, Brazil, were confined to the bud unions and were not the rugose wood symptoms observed on Rough lemon rootstock or the conoid pit symptoms observed on trifoliate-orange rootstock by DuCharme and Knorr (5)

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The similar but even more striking bud-union symptoms of indentation in the wood and bark cracking on trifoliate-orange rootstock with Eureka lemon tops were essentially the same as the symptoms described by Weathers et al. (13) for old-line nucellar Eureka lemon tops on trifoliate-orange and Troyer citrange rootstocks.

The presence of bud-union symptoms of pegs and an orange-yellow ring on the Florida Rough lemon and their absence on Brazilian Rough lemon with the same Pera orange top emphasized the differences in reaction of these Rough lemons. Moreira (8) described other \characteristic differences of these Rough lemon varieties.

### Ribeirao Preto Rootstock Planting

The citrus planting at this sub-station was made 20 years ago. Each scion-rootstock combination was planted in a 10-acre row in each of four blocks. Many of the trees are now missing because of the non-tolerance of the rootstocks such as sour orange to tristeza virus.

The importance of observation in this older planting rests on the fact that some of the Baia navel orange tops were known to be infected with xyloporosis virus as indicated by symptoms on some trees with sweet lime (Lima da Persia) rootstock. It was from this planting that A. S. Costa obtained bark samples that were chemically preserved and sent to Childs (2) for comparison with cachexia on Orlando tangelo.

Observations in this planting showed that many of the surviving Baia navel orange trees were on Rangpur lime rootstock. Many of these showed some decline. Examination of the rootstocks showed no external symptoms of exocortis infection (9). Upon removal of bark patches from the trees in two rows, 12 of 20 trees showed bark pegs and corresponding depressions in the Rangpur lime wood and orange-yellow to dark-brown gum deposits in the bark. These symptoms were present to some degree at the unions but were more pronounced lower on the rootstock. These symptoms might easily be ascribed to either cachexia or xyloporosis. There was no proof of the presence or absence of cachexia, but there was definite evidence of the presence of xyloporosis as measured by the reaction on sweet lime rootstock in this planting. Thus, it seems reasonable to associate the symptoms on Rangpur lime with xyloporosis virus.

The absence of symptoms on some trees with Rangpur lime and sweet lime rootstocks suggests that the buds for this early experiment were taken from more than one tree. No detailed record of bud source was available.

### Commercial Citrus Plantings

The majority of the citrus plantings in Sao Paulo are less than 10 years old because from 1937 to 1947 nearly 8 million orange trees on sour orange rootstock were killed by tristeza virus. Some losses of sweet orange trees on sweet lime rootstocks were due to a combination of tristeza and xyloporosis. Most of the surviving 20- to 30-year-old citrus trees are on Caipira sweet orange rootstock, which is tolerant to both tristeza and xyloporosis. In a few older plantings the sweet orange trees are growing on Rangpur lime rootstock.

In one 24-year-old planting of Barao sweet orange on Rangpur lime rootstock at Bebedouro some trees showed stunting and decline symptoms but no definite external symptoms of exocortis. Bark patches were moved and some showed characteristic xyloporosis symptoms. In an adjacent 4- to 5-year-old planting with the same Barao sweet orange top on Rangpur lime rootstock, about 30 percent of the young trees were smaller than the others. Examination of these revealed typical xyloporosis bark symptoms in the rootstock. Again, it was noted that the symptoms were strong at the root crowns and in many cases they had not reached the bud union 12 to 20 inches above.

These observations did not form a basis for distinction between xyloporosis and cachexia but did indicate that the causal agent, uncontaminated by exocortis virus, was causing some damage in the older planting and appeared likely to cause even more damage in the younger grove.

### Limeira Rootstock Plots

At the Limeira Citrus Experiment Station observations were made in two 20-year-old plantings (8). The first had plots of 9 trees of each rootstock-scion combination in each of 4 blocks and the second, plots of 4 trees of each rootstock-scion combination in each of 4 blocks. Pera sweet orange tops in these plots were from the same single-tree bud source as those in the Tiete planting. None of the sweet lime or Rangpur lime rootstocks showed any xyloporosis symptoms. Likewise, there were no definite symptoms of pegs or discoloration at the bud unions of the Pera orange tops on Brazilian Rough lemon rootstock. Florida


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Rough lemon was not included as a rootstock in these plots. There were, however, 4 plots of 4 trees each of 20 year-old Pera orange tops on trifoliate-orange rootstock. All of these showed some degree of indention at the bud union and an orange-yellow discoloration. The symptoms were similar to those at Tiete but were not as marked.

## DISCUSSION

Because of the similarity of bark symptoms of cachexia on Orlando tangelo to that of xyloporosis on sweet lime rootstock (2), and because of transmission tests (3), cachexia and xyloporosis were considered to be the same and the name xyloporosis was employed. For purposes of this discussion the term cachexia will be limited to the described disease (1) on Orlando tangelo and xyloporosis to the described disease (11) on sweet lime. In Florida abnormal pegs and orange-yellow coloration at the bud-union of sweet orange on Florida Rough lemon rootstock have been associated with the presence of cachexia as expressed on Orlando tangelo test plants (4, 6). It was considered that these symptoms at the bud-union of sweet orange tops on Rough lemon rootstocks might be an indication of presence of the virus that causes cachexia.

The observations at Tiete, Brazil, show that something is wrong in assuming a relation of cachexia and xyloporosis to abnormal bud-union symptoms of pegs and an orange-yellow ring on Florida Rough lemon rootstock. Typical bud-union symptoms were produced on Florida Rough lemon rootstock with Pera sweet orange top, but the sweet lime and Rangpur lime rootstocks with the same tops showed no symptoms of xyloporosis. If one accepts the bud-union symptoms of pegs and an orange-yellow ring on Florida Rough lemon rootstocks as indicative of the presence of cachexia virus then it follows, because of the lack of xyloporosis symptoms on sweet lime, that cachexia and xyloporosis are caused by two distinct viruses. If, on the other hand, the causal agent of xyloporosis is the same as that of cachexia, then the bud-union symptoms on Florida Rough lemon at Tiete would have to be interpreted as due to some other cause such as incompatibility or another virus.

Observations in Brazil, however, indicate that tristeza virus alone or in combination with exocoritis and psorosis viruses had not caused marked bud-union symptoms on the Florida Rough lemon rootstock of the trees observed.

The cause of the marked bud-union symptoms on Florida Rough lemon rootstock with the Pera orange top is not known. The lack of symptoms on trees consisting of Pera orange top on sweet lime (Lima da Persia), which is sensitive to xyloporosis, would indicate that this virus was not involved in this instance. Tests to determine the presence or absence of cachexia virus by bud transmission to Orlando tangelo and tests of clonal and nucellar seedling Pera orange tops on several different rootstocks are underway.

The findings at Tiete of similar bud-union symptoms of pegs and an orange-yellow discoloration on trifoliate-orange rootstock with Pera

**Table 1. Disease symptoms on rootstocks or at the bud unions of different citrus varieties in the experimental planting at Tiete, Brazil(a).**

| Rootstock variety or kind | Hamlin sweet orange top | Baianinha(b) sweet orange top | Maracana sweet orange top | Pera(c) sweet orange top | Mexerica tangerine top | Eureka lemon top |
|---|---|---|---|---|---|---|
| Trifoliate-orange | Bark shelling Exocortis(d) | Bark shelling Bud-union | Bark shelling Exocortis | Bud-union Pegs + orange-yellow ring | 0 | Bud-union Pegs + orange-yellow ring Bark cracking |
| Rangpur lime | Bark shelling Gum spots Exocortis | Bark shelling Gum spots Exocortis | Bark shelling Gum spots Exocortis | 0 | 0 | 0 |
| Sweet lime(e) | 0 | 0 | 0 | 0 | 0 | 0 |
| Florida Rough lemon | 0 | Very few small pegs on bark | Very few small pegs on bark | Bud-union Pegs + orange-yellow ring | — | 0 |
| Brazilian Rough-lemon | 0 | 0 | — | 0 | — | 0 |
| Caipira orange | 0 | 0 | 0 | 0 | 0 | 0 |
| Pera orange | 0 | 0 | 0 | 0 | 0 | 0 |
| Cravo tangerine | 0 | 0 | — | 0 | — | 0 |
| Shaddock | — | — | — | — | — | 0 |
| Cuban shaddock | — | — | — | — | — | 0 |
| Sour orange | — | — | — | — | — | 0 |
| Sampson tangelo | — | 0 | — | — | 0 | — |
| Cleopatra mandarin | — | 0 | — | — | 0 | — |

(a) Each rootstock and scion combination was represented by three trees in each plot with three replications planted December 1948. Each scion variety originated from buds from a single tree.

(b) Baianinha navel orange also has psorosis virus as indicated by leaf symptoms. No psorosis symptions have been found on the other varieties or on the parent trees.

(c) The Perasweet orange was from an old established clone at the Limeira Citrus Experiment Station and by tests considered free of psorosis and exocortis viruses and free of xyloporosis virus as measured by tree development on sweet lime rootstock. Tristeza virus is considered as present in all sweet orange varieties and in the tangerine.

(d) Typical bark shelling on rootstock indicative of presence of exocorotis virus.

(e) Sweet lime (Lima da Persia) shown to be a host for xyloporosis (7).

orange tops might indicate that whatever factor is present in the Pera orange top affects both trifoliate-orange and Florida Rough lemon.

The similar but more extreme bud-union symptoms of indentation in the wood and bark cracking on trees consisting of Eureka lemon tops on trifoliate-orange rootstock would at first appear to be due to a similar but even stronger factor than that present in the Pera orange top on this rootstock. However, the complete lack of symptoms when the Eureka lemon top was on Florida Rough lemon rootstock would indicate that the Eureka lemon was not carrying or producing one of the factors present in the Pera orange top.

Weathers et al. (13) in California showed that nucellar as well as old-line clones of Eureka lemon as tops on Troyer citrange and on trifoliate-orange can cause bud-union symptoms. Their described bud-union symptoms when Eureka lemon was on Troyer citrange and trifoliate-orange rootstocks are similar to, if not identical with, the bud-union symptoms on trees consisting of Eureka lemon tops on trifoliate-orange rootstock that we observed at Tiete. Weathers et al, suggested that this disorder as observed in California may be caused by a virus or by a form of incompatibility between the Eureka lemon top and Troyer citrange.

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Nearly 2,000,000 pine seedlings are being planted in Florida this season, according to Tom Herndon, forester with the Agri. Extension Service.

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**Don't miss the Florida Citrus Exposition at Winter Haven, Feb. 15-22.**

## H. W. VON LOESECKE DIES JANUARY 19

Harry Willard von Loesecke, veteran research scientist of the U. S. Department of Agriculture and one of the country's outstanding food technologists, died January 19 in Washington, D. C., after an illness of several months.

Widely known for his contributions to improved processing of citrus fruits and to research on dehydration of fruits and vegetables, Mr. von Loesecke was serving at the time of his death as a member of the Internal Audit Staff of USDA's Agricultural Research Service. He had completed 27 years of Government service.

In 1931, Mr. von Loesecke was appointed chemist in charge of USDA's Citrus Products Station at Winter Haven, Fla. Work done there under his direction contributed to important improvements in pasteurization and other aspects of the processing of citrus fruits and juices.

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## STORAGE STUDIES ON MARSH GRAPEFRUIT—55-56 SEASON

(Continued from page 16)

percent in the continuous 50°. That for 1 week at 50° then 5 weeks at either 32° or 40° resulted in a considerable reduction of decay compared to continuous 50°. Storage for 6 weeks at 40° also gave a low percentage of decay. At the end of the holding period the results were quite different, Fruit stored 6 weeks at 32° had 77 percent decay and that in the other treatments ranged from 36 to 48 percent decay.

Total soluble solids increased 0.4 to 1.1 percent and total acid decreased 0.07 to 0.24 percent during storage (table 9). Fruit stored at 50° for 6 weeks were a little deeper in color than those in other treatments and all of them tended to darken in shade during the holding period. Flavor of the fruit was acceptable in all treatments.

**Test 6.** Three percent pitting was found in fruit stored 6 weeks at 32° and none in other treatments when the boxes were removed from storage (table 8). Pitting developed rapidly in some lots between the first and second inspections and decreased between the second and third inspections as injured fruit succumbed to decay. More pitting was found in the Pinellas County fruit than in Lake County fruit. No severe aging was recorded.

The percentage of decay was generally lower in the Pinellas County fruit than in the Lake County fruit. Unlike results noted in the 8-week test, fruit stored 2 weeks at 50° then 4 weeks at 32° had less decay at the end of the holding period than other treatments. Fruit stored 6 weeks at 40°, 1 week at 50°, then 5 weeks at either 32° or 40°, and 2 weeks at 50° then 4 weeks at 40° all had approximately the same amounts of decay. While too high to be of much practical value, decay in these treatments was 8 to 10 percent lower than continuous 50° and very much lower than continuous 32°.

Value for weight of fruit that was juice, total soluble solids, total acid, and acidity (pH) before storage and after the holding period are given in table 9. Rind color and flavor of the fruit were similar to those of test 5.

The results of the two 6-week storage tests indicate that the curing effect of a short storage period at 50° is most prominent in fruit less prone to decay. Pitting was unusually low in the 40° treatments as tests in previous years (3, 4, 7, 9) have generally shown more rind breakdown at this temperature than either 32° or 50°. Less pitting was usually found in fruit with less decay.

**Test 7.** Little pitting was found when the fruit was removed from storage (table 10). Fruit stored for 8 weeks at 32° showed 4 percent pitting while that stored 1 week at 50° then 7 weeks at 40° had 3 percent severe aging. Pitting developed rapidly during the holding period. Many of the injured fruit decayed so that the amount of rind breakdown was smaller at the third inspection. Severe aging was found in many of the 6- and 9-week treatments.

Fruit stored at 50° for 4, 6, or 8 weeks had 17, 27, and 33 percent decay, respectively, on removal of the boxes from storage. By contrast, fruit stored 1 week at 50° then 3, 5, or 7 weeks at 32° had 1, 1, and 2 percent decay, respec-


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tively. These same fruit had 2 to 3 percent decay after 3 days at 70°. Decay developed rapidly in all of the fruit between the third and seventh day of the holding period. Storage for 1 week at 50° before transference to 32° did, however, result in much less decay than either continuous 50° or continuous 32°.

The weight of fruit that was juice and total acid decreased during storage and the holding period (table 11). Total soluble solids increased 0.1 to 0.5 percent in fruit stored 4 and 8 weeks and decreased 0.1 to 0.2 percent in fruit stored 6 weeks. Solids-to-acid ratio increased and acidity (pH) gradually decreased during storage. Fruit stored at 50° were noticeably deeper yellow in color than the rest which were light yellow for the most part. All of the fruit darkened somewhat with increased length of storage and also during the holding period. Flavor of the fruit after 4, 6, and 8 weeks of storage was acceptable.

The findings in the 4 storage tests with Marsh grapefruit obtained from commercial packinghouses bear out in general the results reported in previous years (1, 3, 4, 7, 9) for fruit stored continuously at 32°, 40°, or 50° F. Very little pitting or other rind breakdown developed in the fruit until the last 2 tests and then it was generally most severe at 32°. Fruit picked early in the season could be stored for longer periods with less development of decay. Fruit stored at 50° nearly always had more decay than fruit stored at 40° or 32° when the boxes were removed from storage. Decay in fruit stored at 32° was usually very low but surface browning (scald) often disfigured the fruit. During the first 3 days of the holding period decay increased rather slowly but developed rapidly thereafter.

Rind breakdown did not become prevalent until the last 2 pickings and frequently was lower in fruit stored at 40° F., with or without previous storage at 50°, than in fruit stored at 32°. While it did not appear to affect the amount of rind breakdown, storage at 50° for 1 or 2 weeks before transference to 32° eliminated most of the surface browning found in fruit stored continuously at 32° and also prevented the appearance of the objectionable deep yellow color found in fruit stored continuously at 50°.

Less decay developed during the holding period when the fruit was stored for 1 or 2 weeks at 50° F. before it was transferred to 32°. In most cases, the shorter period at 50° gave better results. Some reduction in decay was also obtained when the lower temperature was 40°. Storage of fruit first at 32° then 50° was not successful as the amount of decay was higher than when held continuously at 50°.

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## GOVERNOR AND CABINET TO APPRAISE FRUIT DAMAGE

Governor LeRoy Collins, his cabinet and other high state officials, along with members of the state legislature will get an opportunity to fully appraise recent freeze damage as well as the attitude of the growers and other industry people when they visit Winter Haven Wednesday, Feb. 19.

This date has been set for the annual observance of "Florida Agricultural Day" as a feature of the 1958 Florida Citrus Exposition which will be staged here Feb. 15-22.

In commenting on the scheduled visit of the governor and other officials, Winston Lawless, president of the industry-sponsored citrus show said, "the Florida citrus industry will, by Feb. 19, have an opportunity to more fully appraise the overall damage to fruit and trees from the December and January cold spells, and Governor Collins can see for himself just what is happening to the state's citrus fruit deal."

Lawless said that Collins would speak at an invitational luncheon to be staged in Nora Mayo Auditorium of the Florida Citrus Building and is expected to comment on the state of the industry as well as its future prospects and what the state of Florida can do to aid in the full recovery from the disaster.

It is anticipated that most of the state's political figures, at the federal, state, county and municipal levels will be included in the guest list for the luncheon.

## ROADSIDE FRUIT STANDS UNDER CLOSE INSPECTION

The Florida Citrus Commission, in keeping with its avowed policy to protect the consuming public, has served notice on Florida roadside fruit stands that a law which prohibits the sale of freeze-damaged or "unwholesome" citrus fruits will be enforced.

General Manager Homer E. Hooks said an additional inspector has been assigned to the task of checking on roadside fruit stands and the condition of citrus fruit they are selling to tourists. This brings to two the number of men assigned to this category, he said.

Wm. H. Baur, a member of the Commission's merchandising division, has been designated a special inspector for the purpose, Hooks declared. Baur, a member of the Commission's staff for the past 11 years, had served three years previous with the State Inspection Service and is well qualified to carry out his new duties, he said.

"Most roadside stands are being careful not to sell free-damaged fruit to tourists and other consumers," Hooks stated. "However, few are violating the law and can bring discredit upon the entire industry.

"It is another step toward achieving the Commission's policy of guarding the good name of Florida citrus products and protecting the public against fraud and poor quality fruit," Hooks added.

According to state law, contained in the Florida Citrus Code, no fruit may be sold or transported which shows more than 15 per cent serious freeze damage. The Code also provides that it is unlawful to sell or transport any citrus fruit that is unfit for human consumption. Violators are subject to a fine of $1,000, a year in jail, or both.

Baur joins E. G. McDonald who has been a roving inspector for the Commission, devoting much of his time to checking express fruit shippers and gift fruit stands.


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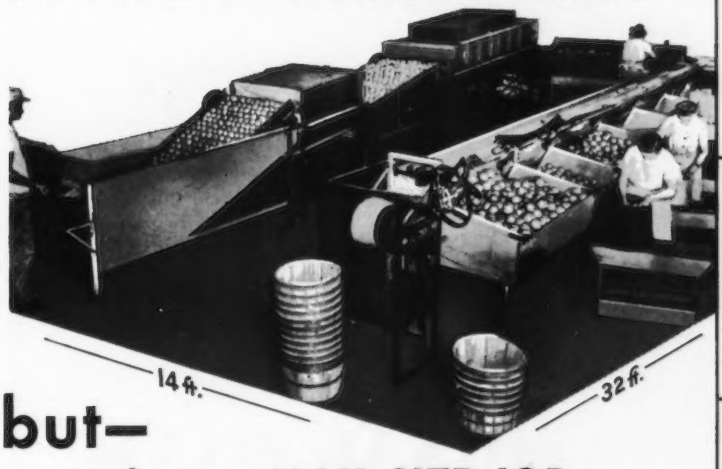


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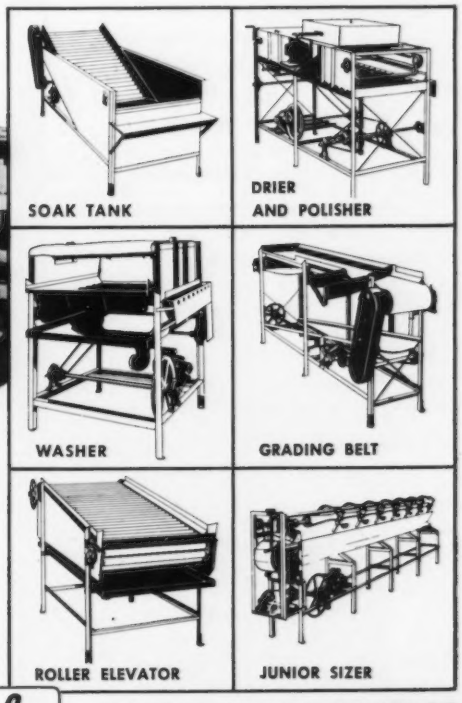


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## *Daily Schedule*

**Florida Citrus Exposition**
**Winter Haven**
**February 15-22, 1958**

**CHILDREN'S DAY**
**Saturday—10 a. m.-8 p. m.**

Opening Parade
Dancing Waters, Amphitheatre
**Sunday, 8:00 p. m.**
Dancing Waters, Amphitheatre

**IMPERIAL POLK COUNTY DAY**
**Monday—7:30 p. m.**

Queen Contest, Amphitheatre
Dancing Waters, Amphitheatre

**CANNER'S DAY**
**Tuesday—12:30 p. m.-7:30 p. m.**

Canner's Luncheon, Nora Mayo Hall
Queen Contest, Amphitheatre
Dancing Waters, Amphitheatre

**AGRICULTURAL DAY**
**Wednesday—1:30 p. m.-7:30 p. m.**

Agricultural Luncheon, Nora Mayo Hall.
Queen Contest Finals, Amphitheatre
Dancing Waters, Amphitheatre
Coronation Ball, Nora Mayo Hall

**FRESH FRUIT DAY**
**Thursday—2:30 p. m., 5:00 p. m. and 8:00 p. m.**

Fresh Fruit Auction, Nora Mayo Hall
Fruitman's Dinner, Armory
Dancing Waters, Amphitheatre

**PRESS, RADIO AND TELEVISION DAY**
**Friday—7:00 p. m.-8:00 p. m.**

Press Breakfast, Nora Mayo Hall.
Dancing Waters, Amphitheatre

**ALL FLORIDA DAY**
**Saturday—8:00 p. m.**

Dancing Waters, Amphitheatre

The James A. Strates Shows will be on the Midway, open daily 10:00 a. m. to 12:00 p. m., Saturday to Saturday, closed Sunday.

## HOME SAFETY SHOULD BE REMEMBERED WHEN ELECTRICITY IS USED

If you are an average American citizen, you are probably enjoying a typical "electrical life". We do not give much thought to this life of comfort and convenience. Thus we never stop to consider the safe practices that should be remembered in using electricity.

The full value you get from electricity depends to a great extent upon how you safeguard the electric service in your home.

In thinking about safety in electricity, one of the first questions you might ask yourself is, "Has my house outgrown its wires?"

Danger of fire is one of the main hazards in having a house that is underwired. When too many appliances are operated at the same time on undersized or overloaded wires, the wire becomes heated and the coverings or insulataion may wear, allowing live wires to come in contact with each other. This results in a "short circuit" and possibly a serious fire. Many houses are equipped with circuit breakers or fuses that will blow in case of overloading.

Since most of us are not qualified electricians, we cannot rewire the house, but we can carry out some safe practices in the home such as:

1. Never run cords under rugs. They become worm and may cause a short circuit and a fire.
2. Do not place cords in door jambs. Squeezing like this breaks the protective covering.
3. Never leave heating appliances connected when not in use. Fire is frequently caused this way.
4. Do not disconnect appliances by pulling on cord. This lossens the connection and is a frequent cause of trouble.
5. Never use cord as a substitute for permanent and properly installed wiring.
6. Examine cords regularly, and replace worn ones to prevent short circuits.
7. Insist on approved labeled cords with appliances, lamps and cord attachments.
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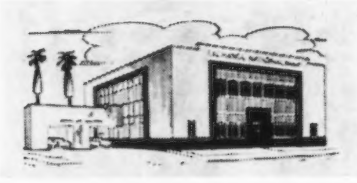

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# Possibilities And Problems In Marketing Of Lychees

GORDON PALMER
PRESIDENT, LYCHEE GROWERS ASSOCIATION
AT CITRUS SUB-TROPICAL INSTITUTE, LAKE PLACID

The marketing of Florida lychees is handled by the Florida Lychee Growers Association, a grower cooperative with some 85 members who represent all but a negligible fraction of the commercial lychee groves in the state. The fruit is sold fresh, and marketing procedures such as sales and billings are handled by a central marketing agent who distributes orders for fruit among various growers as these orders come in. At the present time each grower does his own picking and packaging of his fruit and delivers it to the nearest airport for air shipment to stores and restaurants all over this country and Canada.

The 85 growers represent plantings of some 250 to 300 acres with a total tree count of about 13,500 and it is estimated that the potential crop with the trees now planted may some day amount to perhaps 2-½ to 3 million pounds annually. At the present time fruit sells for 75c per pound f.o.b. airport of shipment in Florida. Eventually it is believed that increased production and streamlining of handling methods of fresh fruit will make it possible to offer lychees on the New York market, for instance, at something like 30c per pound wholesale.

In 1953 the Association marketed a 9,500 pound crop. In 1954 and 1955 it worked through the Florida Citrus Exchange to market 7,500 pounds in 1954 and 25,000 pounds in 1955. In 1956 and 1957 the Association did its own marketing again, with a crop of 20,000 pounds in 1956 and 14,500 pounds in 1957. Parting company with the Citrus Exchange after two years was on a mutually friendly basis. Both agreed that the Exchange could not economically divert its efforts from its regular fruit distribution business to pioneer a new and highly specialized product.

It is apparent from the above poundage figures that the bearing habits of the young lychee plantings in Florida cannot yet be depended upon. But in these first formative years of lychee production on a commercial scale, while the trees are still small and until horticultural techniques are better perfected, it is natural to expect wide variations in the size of the crop from year to year.

### Prospects For 1957

Last autumn the Association realized that depending on the extent of approaching bloom and fruit set, the Florida lychee groves had reached a size and age where a bumper crop in 1957 could amount to 50,000 or even 75,000 pounds. To move this amount of fresh fruit would require substantially more sales effort than ever in the past, perhaps even a whole new approach, since the marketing of the lychee as a fresh fruit in its present state of development presents serious problems. At the moment, more time is needed for horticultural research toward extending the season during which the fruit matures, and more experimentation must be done with improved packaging and preservation techniques to extend the shelf life of the fruit after it is picked. Until these two things are accomplished (which may well not be until the crop has reached several hundred thousands pounds in size) the Association is charged with the responsibility of selling a highly perishable fruit which ripens over a period of less than six weeks, with the major portion of the crop coming in a 10-day period in the middle of the season. It had always been known that the lychee may be frozen or dried or canned or otherwise processed to eliminate the perishability hazard and to extend the season to a year-round basis. But no investigation had ever been made of the potential markets for the lychee in its various processed forms, or the risks and costs of opening

(Continued on page 44)

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*R. J. Patrick*

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## Reports Of Our Field Men . . .

### SOUTH POLK, HIGHLANDS, HARDEE, DeSOTO AND SARASOTA COUNTIES

C. R. Wingfield
Avon Park, Fla.
Phone Glendale 2-81881

We are still in the grip of winter weather. Since the December freeze temperatures have been down to freezing or near freezing several times. Each time it would take another bite at the already badly damaged citrus trees.

The early January frost (with some ice) killed most of the new tender growth that had come out on the defoliated limbs. Since that time very little has come out because it has stayed cold. This perhaps is for the best for there is less chance for frost to kill the shock growth.

There continues to be the salvage job of moving partly damaged fruit and it is bringing us closer to the Valencia deal. Everyone is talking about what price we are to get for Valencias. This is still the big question but I think the after freeze quality will be a factor.

As to feeding damaged trees, we must admit the new growth needs sufficient plant food, both major and minor elements, to produce good healthy wood. Therefore make a careful study of the individual needs and feed it accordingly.

### HIGHLANDS AND POLK COUNTIES

J. K. Enzor, Jr.,
P. O. Box 1364 Winter Haven, Fla.
Phone Cypress 3-4716
R. E. Lassiter, Jr.,
1168 Lakeshore Blvd.
Lake Wales, Fla.
Phone 3-3813

At the time of this report we are only 5 days away from our last cold wave of Jan. 10th and it is very difficult to assess the damage at this time. A good portion of the new growth that had appeared since the December freeze was burned severely, however we have seen some which seemed to be in fair condition. It will take a few more days to tell us the whole story.

In talking with growers we have gotton the impression that a lot of people are assuming that the cold weather has completely solved all of their insect problems. This is far from the actual conditions. In the case of Red Scale this assumption is probably correct. Most of it has been killed, however in the case of mites, this is not true. Texas Mites seem to be less numerous than before, but where they were heavy before the cold Purple Mites are still heavy. Rust Mites are still present also. Additional leaf damage, after the cold damage, from insects seems to us to be very undesirable. Where Purple Mites are to be controlled the grower should pay particular attention to the condition of his new growth. If there is young tender growth he should be careful to use a miticide that will not harm this growth.

In view of the amount of damage we have suffered from the cold weather it is very important that a good Spring fertilizer be applied in order to promote rapid and strong tree recovery. If trees, which have been hurt the second time, show signs of starting to grow again in the next few days it is our opinion that these trees should have an application of fertilizer right away in order to make that growth just as strong as possible. This type growth will probably be weak at best.

### NORTH CENTRAL FLORIDA

V. E. Bourland
Winter Garden, Fla.
Phone 107

We are winding up one month of miserable weather, it has been very discouraging and depressing to drive around and through groves, and talk to the growers since everything looked so good and prosperous, with the largest fruit crop, and best quality in years before this damage, but I try to encourage them, and recommend Lyons Fertilizer when needed, for a quicker comeback.

Lots of fruit is being moved, and in spite of what we called miserable weather, it has proven favorable for the grower to salvage his fruit. Lots of groves are defoliated, and where there wasn't severe damage to the wood, trees have new growth started, but the recent cold got some of that, therefore the growers are at a loss as to what to do next.

### WEST HILLSBOROUGH AND PINELLAS COUNTIES

J. A. Hoffman, Lutz, Florida
Phone WE 9-2276

Although we've had a very cold winter since the freeze early in Dec. most groves look very good in this section. Even though the weather has been cool since the freeze trees are budding out, putting on new growth and blooms. In some cases growers are going ahead and applying the usual fertilizer program.

Most early and mid season oranges have been picked at this time. A very small percentage was damaged beyond use in canned juice.

### EAST HILLSBOROUGH AND PASCO COUNTIES

E. A. McCartney
914 River Hills Dr.
Temple Terrace, Tampa, Fla.
Phone WE 8-2852

As of this date, January 17th, there is some question as to the best procedure regarding bearing trees that were hurt by the freeze and lost one-third or more of their fruit having in mind next season's crop which means getting a bloom and having it stick on the wood that was not too badly damaged. We have had some new growth since the December freeze but that has been killed in most of this section, Hillsborough, Pasco, Hernando and Citrus Counties.

### SOUTH HILLSBOROUGH AND MANATEE COUNTIES

Eaves Allison
P. O. Box 365, Sarasota, Fla.
Phone Fulton 8-2611

We have had some favorable weather since the December freeze which has softened the blow. Several good rains have refreshed the damaged trees and plants, and continued cool weather has prevented too much vegetable growth.

Spring tomato acreage is up about thumb-high at this time, January 14th, and it is upon these young plants that we are depending for part of our come-back.

Citrus in this section will pick out a whole lot of boxes and all in all I have an idea we will at least break even when the accounts are cast up.

ADVERTISEMENT — LYONS FERTILIZER COMPANY

## *Uncle Bill Says:*

It ain't no secret that I've been follerin' Lyons Fertilizer recommendations ever since they started in business. 'n I've always found 'em sound and helpful, so I checked with 'em last week and asked how they felt I should handle the present situation. Their advice sounded so sensible I thought I'd pass it on to you.

They told me that where there has been severe damage to the wood they'd recommend that the growers use a complete fertilizer like a 4-6-8, a 6-4-8, or a 6-6-8 containin' high percentages of Magnesium, if a nutritional spray ain't goin' to be used, with at least half a unit of Manganese. They said if'n the loss of terminal wood amounts to 25 percent the application should be reduced one-fourth of the normal application, and if the loss of wood is greater the application should be reduced in proportion. They also told me where there is terminal wood loss application of spray was goin' to be needed to control melanose.

This spray, they said, should be applied when new leaves is half to three-quarters of an inch in width and since leaves of this size is hard to cover they said to use a spreader and sticker to really cover the foliage. If Manganese ain't been used in the fertilizer they said Manganese and Zinc can be applied in this spray.

They said now ain't the time to prune deadwood from trees. This can be done when the cold damage is completely apparent.

Where trees has lost all their foliage they told me to use the same complete fertilizer as recommended on severe or partially damaged trees. The heavy rains has made trees hungry for plant food and they'll need it to produce new foliage.

Where there ain't bin no freeze damage they said there ain't no reason to vary your normal fertilizerin' program 'ceptin to increase the amount of fertilizer applied so as to set more fruit in anticipation of higher prices in the comin' season.

Lyons folks said they agreed with the Citrus Experiment Station folks that tryin' to use the cheapest method possible of fertilizin' was false economy, 'cause groves need more complete feedin' now than at any other time.

Some folks say they ain't no need for insecticide control right now, but in spite of some insects bein' killed off the ones that is left will be jist as active as before the cold spell and trees will be easier hurt by insects than before so long as you don't use a miticide that will injure succulent growth.

We also asked when fertilizer should be applied and they told me that they ain't no way to stop new growth once it gits started, and while the customer is takin' what they call a "calculated risk" of more cold injury if'n he happens to be hurt by cold later this month, it may be a good gamble 'cause well-fertilized trees will stand cold better'n those that ain't been fertilizer. If the grower is more conservative they said then it would be well to wait 'til about February 15th before fertilizin'.

All of which sounded like good advice and we're goin' to follow it.

# John A. Snively, Sr., Citrus Leader, Dies

The death of John A. Snively, Sr., at the Winter Haven hospital January 22nd, marked the passing of one of the outstanding figures in Florida's great citrus indutsry.

JOHN A. SNIVELY, SR.

Snively was president of Snively Groves, Inc., and has been active in Florida's citrus affairs throughout his life, as well as being a major influence in Winter Haven's civic development. He was also founder of Polk Packing Association.

In 1938, 1939, and 1940 he served on the Winter Haven City Commission.

Born in Schellsburg, Pa., nearly 68 years ago he came to Winter Haven at the age of 21 and had lived there since that time. At the time of his death he was nationally known as a citrus grower, shipper and processor.

He had been in ill health for some time, but still retained active interest in his business affairs which of late have been conducted under the direction of his son, John A. Snively, Jr.

Funeral services were held January 24th from the First Presbyterian Church in Winter Haven and interment was made in Lakeside Memorial Park.

## POSSIBILITIES AND PROBLEMS IN MARKETING OF LYCHEES

(Continued from page 40)

these markets.

### Counsellors Employed

Last fall the association decided that the time had come for a professional survey and analysis of the lychee industry as a whole, its future commercial possibilities and the means of achieveing these possibilities. Accordingly the point service of two New York firms, was employed -Lester Cone & Associates, Sales Development Counsellors, and the J. P. Lohman Organization, Public Relations Specialists. Representatives of the two concerns came to Florida and everything was discussed with them about the lychee today from the point of view of the grower. They were asked to analyze this information and evaluate it from the point of view of the buyer—the wholesale trade, the retail trade and the ultimate consumer. On the basis of their findings they were to draw up a report covering, first, a flexible plan or roadmap to guide the industry's activities in the foreseeable future, and, second and more specifically, a recommendation as to how the 1957 crop should be marketed. They spent six weeks in New York working on this survey, going into every phase and angle of the lychee's possibilities as a marketable product and came up with a report in many ways quite remarkable for the exhaustive amount of sound information and advice it contained. The report was accepted, and the Association has since proceeded on the basis of its recommendations.

Before going into the problems of marketing lychees as the growers see them and as the New York specialists analyzed them, let us look a little bit into the background of this new Florida fruit.

### Character of Fruit

The lychee fruit grows in clusters on large and beautiful evergreen trees. The trees now planted in Florida bloom usually in early winter and the fruit begins ripening about the first week in June. The harvest may go on for as long as six weeks, normally starting slowly, then growing rapidly to a peak the first of July, followed by a rather sharp tapering off. The fruit itself reaches the size of a large strawberry, an extremely appealing dark red in color. Peeling back the rough outer skin reveals the edible white flesh, delightfully juicy and grape-like in texture, sweet to the taste and with an illusive and subtle delicacy of flavor all its own. The flesh surrounds a free-stone seed.

The fruit, however, is highly perishable with a shelf life of perhaps 7 to 14 days, depending on the degree of ripeness when picked. The grower has almost no latitude in the time of picking—the fruit will not ripen off the tree if picked underripe and once ripe on the tree it must be picked right away because overripe fruit spoils almost in a matter of hours.

### Historical Background

Historically the lychee has a fascinating and romantic background. It ranks among the oldest of any known fruits, having originated in China, probably some 3,500 years ago. For centuries its praises have been sung in Chinese literature and legend, and an early treatise on the lychee, written in 1059 A. D., is still in existance today.

From China the lychee spread to other areas with favorable climatic conditions and today it is widely grown in India, as well as China. There are many different varieties arising from seedlings plantings thru the centruies. It seems that most

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of the fruit in China and India is consumed fresh, although the Chinese process some in cans and they also dry some of it. Both these later products find their way to America and many people are familiar with the Chinese laundrymen's traditional handing out of dried lychees, or "lychee nuts", at Christmastime. South Africa has had the lychee for 100 years or more. Their present crop, from commercial plantings started about 25 years ago, amounts to a million or more pounds annually. Most of this South African fruit is consumed fresh locally, and though some attempt has been made to ship it to England under refrigeration, this has not been too commercially successful.

The agricultural stations in South Africa have experimented with freezing, canning, and drying, but only on a trial basis.

Hawaii has had the lychee for many years but it seems that none of the so-far known varieties will produce a commercial crop there. Lychee trees also grow in California, but again for some reason of climate or soil they will not produce a commercial crop. In fact, the only place in the Western Hemisphere where lychees at the present time are being produced as a marketable product is in Central and South Florida.

The lychee was introduced into Florida in the 1880's but remained in the novelty category until the 1940's when Col. William R. Grove began experimenting toward developing a new commercial sub-tropical fruit crop for Florida. With his discovery and perfecting of a method of propagation by marcottage using plastic film, quantity production of true-to-variety lychee nursery stock became practical and the lychee was launched as a commercial proposition. In 1951, largely through the efforts of Col. Grove and the growers he had interested in the lychee, the Florida Lychee Growers Association was formed. It is significant that the lychee industry was able to organize its marketing cooperative right from the beginning of commercial production, and thereby avoid the headaches and struggles that have tormented other agricultural industries when growers have tried to get together long after their product has been on the market.

### Marketing Survey

In the marketing report from the Lohman-Cone group, their first conclusion was that today's lychee, in spite of certain drawbacks, had enough commercially exploitable good qualities for a profitable market to be built on it. They felt that the lychee should be considered an exotic luxury fruit and marketed as such in the forseeable future. In evaluating the lychee in its various forms, they pointed out that in its fresh form it offers maximum taste value to the ultimate consumer, and from the growers standpoint, minimum processing costs, warehousing costs and packaging costs. On the other side of the balance, fresh fruit has serious disadvantages. The first is that as yet it has almost no consumer knowledge or acceptance and this means it requires special sales promotion by the retailer. A retailer is much more inclined to give a product special promotion if he knows he will be rewarded by repeat sales. Because of the lychee's extremely brief harvesting season, the dealer has only a short time to cash in on repeat sales. Further, the lychee's short shelf life adds a possible spoilage problem. For a specialty food store which attracts its trade by continually offering something new and exciting in the way of a good product, the fresh lychee has appeal as a novelty fruit of real merit. But for a high-turnover supermarket type of store, the fresh lychee's disadvantages outweigh its novelty value and its merit. These same disadvantages apply to the wholesaler equally as to the retailer. A further consideration in the marketing of lychees as a fresh fruit is the difficulty in estima-


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ting the size of crop each year, which makes it extremely difficult to gauge advance promotional expenditures exactly to fit the supply of fruit. Overselling the crop by too much promotion will be wasteful; underselling will leave unmarketed fruit on hand. Lohman-Cone's conclusion was that while there will always be a growing market for fresh fruit, the future of the lychee in its present stage of development should not be based on the fruit in its fresh form.

### Processing Methods

Many of the fresh fruit problems can be solved by freezing the fruit. The flavor of frozen fruit is good, and the processing needs not necessarily be complicated by the expense of special preparation. Available citrus freezing capacities exist here in Florida during the lychee season and the resulting product is one which will be available in year-round supply for the dealer's repeat business he is looking for. Offsetting these advantages are the technical problems of properly freezing and holding frozen fruit to retain its quality. Even when standards are established, frozen products are extremely difficult to handle in a way that the standard requirements will be constantly maintained. Even subfreezing temperatures which vary may be a great detriment to the quality of the product. Also frozen food space in the retail store commands a big premium and dealers will only reluctantly stock a frozen product that does not turn over rapidly. Slow turnover of the lychee can be expected while it is still new and unknown to the public. Another factor might be that the frozen fruit might first have to be processed in some way to make it saleable. Even if from a technical point of view lychees can be frozen satisfactorily "as in", skin and all, from a merchandising point of view, it could well be that as a matter of convenience in the home, the public would buy them only if they were peeled and pitted before freezing.

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Canned lychees would solve the same problems of perishability and short season as in the case of the frozen, and especially if the frozen have to be peeled and pitted, canned lychees offer the advantages of easy storage and handling without concern for temperature changes or other causes of spoilage. Quality, however, may suffer in the canning process, and canned lychees are subject to competition from the Chinese, and possibly from South Africans, both of whom have much lower labor costs than here. It may of course be possible at some time to get legislative protection in the form of import tariffs.

Dried lychees are the form in which the lychee is now best known to the public. The drying process is a simple one except that the loss of weight through drying greatly raises the value of the dried product, since it may take two or three or four pounds of the fresh fruit to make one pound of the dried. Here again there is the matter of competition from China and South Africa, even with protective tariffs. The suggestion was made, however, that dried lychees offer a great variety of packaging opportunities, both dried in the shell as well as in the form of dried flesh after peeling and pitting. Small packages of shelled nutmeats for gift or cocktail dishes bring a high price in specialty stores.

This leads to the possible uses of the lychee as a specialty product—brandied, pickled, or glazed or stuffed, for instance, or in juice form. An acceptable lychee wine would offer untold possibilities because there does not seem to be any traditional wine or cordial to go with Chinese meals, now gaining such popularity in restaurants and at home. Profit margins in this field are high. Finally, there is the possibility of using lychees as an ingredient as a flavoring for gelatin, ice cream, sherbert, soft drinks, and the like. All in all, it seems that there are almost endless forms in which the lychee might be utilized. Their successful use, of course, is dependent entirely upon processing costs and public acceptance of the final product at these costs.

### 1957 Crop

Lohman-Cone's specific recommendations for future planning were that in 1957 efforts must necessarily be directed to selling the crop as fresh fruit. At the same time they urged that the Association plunge heavily into developing new processed lychee products, alloting as much fruit, time and money to these experimental endeavors as could be afforded.

This year with a poor bloom and poor fruit set, the 14,500 pound crop handled by the Association presented no marketing difficulty. First of all, old customers gave pre-season orders in substantially increased quanities this year over their pre-season orders last year. A new agent was appointed to handle the New York Chinatown market which during the past few years had always taken about half the crop. The single promotion this year was a feature article along with a paid advertisement in the May issue of Telefood Magazine, a trade publication going to specialty food dealers. Before the season even began, an encouraging flow of trial orders had been received from this source, just about doubling the number of non-Chinese customers from former years. In all, some 8,000 pounds of fruit were on order at the start of the harvest, not including commitments from New York Chinatown.

(Concluded Next Issue)

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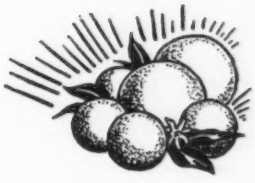
Fresh anned Juices And Sections

Concentrated And Chilled Citrus Sections



## Don't Miss The Florida Citrus Exposition

. . . Winter Haven . . .

## *February 15 Thru 22*

"A Treat You'll Enjoy"

# The Past Is Past . . . Now Is The Time To Plan For The Future

A lot of Florida's citrus growers have a lot of different problems as a result of cold damage so there is not a single rule which all growers may follow to get their trees into the condition they want them to be so they will build a crop of good fruit for the coming season, when higher prices may be anticipated.

Our sales and consulting service men have made the most exhaustive study of the proper means of accomplishing this purpose . . . not only drawing upon their own knowledge and experience but in consultation with the most capable, recognized authorities, upon the proper methods of fertilization and spray programs to recommend to our cutomers and to all other growers who may desire to avail themselves of the conclusions they have reached.

So we urge you to plan for the future and to set your sights upon the objective of getting your trees in the finest possible condition to produce the biggest and best crops you can raise.

And, of course, Lyons Fertilizers, used as recommended, will assist in accomplishing this objective, as they have done for many of the state's most successful growers throughout the years.

*LYONS FERTILIZERS Produce MAXIMUM CROPS Of FINEST QUALITY*

**Lyons Fertilizer Company**

Phone 43-101

TAMPA, FLORIDA